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Precooling of Strawberries

By

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AND

WILEY D. POOLE

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Precooling of Strawberries

HAROLD T. BARR AND WILEY D. POOLE

INTRODUCTION

It was recognized by Powell (6) some 35 years ago that there was a more rapid and economical method for reducing the temperature in fruit than that of using ordinary refrigerator cars.

Large cold storage plants for the storage and possible precooling of fruits have been available for many years, but have been limited to concentration points and large operators. A practical and economical precooling system within the financial reach of the packer at the small loading points was described by Galloway (3) in 1929. This precooling apparatus was used in experimentally precooling several cars of strawberries in the Carolina and Florida sections during the spring of 1929.

A few carloads of strawberries were precooled in Louisiana in 1932. In the 1933 season the number of precooled cars increased, as the berries in precooled cars were selling at a premium of from five to twenty-two cents per crate over those in the non-precooled cars. Later it was found that precooling gave an appreciable decrease in decay in transit, and as a result virtually all the express carload shipments of strawberries in Louisiana have been precooled during the 1934-39 period.

The production of strawberries in Louisiana is centered around Hammond in Tangipahoa Parish, and the average yearly production for the years 1930-39 was 2,848 cars (736 crates each). The plants are set out from nursery rows in the late fall and early winter, and there were an estimated 22,000 acres harvested in 1938, according to the Bureau of Agricultural Economics, United States Department of Agriculture. This acreage is divided among some 10,000 growers who depend almost entirely upon strawberries for their cash income and grow little or no other crops.

Louisiana strawberries are harvested from three-fourths to full color, and are inspected by government agents upon delivery to cars. As a rule, only U. S. No. 1 strawberries are shipped. The unclassified and overripe ones are sold either for local consumption or to the cold-pack plants. The inspection of strawberries is compulsory and is carried out by inspectors working under the direction of the Louisiana State Market Commission under a cooperative agreement between the Louisiana State Department of Agriculture and the U. S. Bureau of Agricultural Economics.

The strawberries are shipped in standard crates containing 24 wood veneer pint cups. The cars are loaded with the crates eight rows wide and four layers high with 23 stacks per car. This puts

12 stacks in one end and 11 in the other, with bracing at the doorway between the two ends of the load. Wooden strips are placed crosswise of the car on each layer of crates and nailed to each crate so as to prevent movement of the crates in the car during shipment.

From the time berries arrive at the car until they reach the ultimate market there is a race against time. The railroads run a special strawberry express which leaves the district about six o'clock in the evening and maintains a schedule faster than passenger service through to Matoon, Illinois, where some cars are diverted to the East and others go on to the Chicago district.

The more advanced the berries are in color and the nearer they are to proper maturity for the highest eating quality, at the time of picking, the greater is the need for precooling. The ripening process continues after harvesting and may even be accelerated, depending upon the surrounding conditions. Overholser and Moses (5) found that the rate at which fruit ripens may be reduced one-half for each 15-degree (Fahrenheit) drop in the temperature at which fruit is held, within the zone of ripening temperatures.

PRECOOLING

Precooling can be defined as a form of refrigeration used for rapid removal of field heat as soon after picking as possible and before shipping. The temperature to which a product is precooled is generally such as will definitely retard the ripening process and arrest or prevent mold growth. The Louisiana State Market Commission requires a maximum temperature in the doorways of 45° F. for strawberries in order for a car to be listed as "precooled." They recommend 38° to 40° as the proper temperature. Cars thus precooled have been shipped successfully to Maine and Canadian points.

Precooling makes possible the reaching of more distant markets and the marketing of vine-ripened and higher quality products which command a premium price. It also markedly reduces the losses from rots, molds, and overripening during transit.

Precooling Methods

Precooling may be accomplished by four distinct and different methods: by warehouse cold storage; by spray or baths before loading into the car; by portable mechanical refrigeration units; and by means of fans, placed at the top bunker grill, after loading into the refrigerator car.

Warehouse cold storage has not been used in Louisiana to date except for storing cold-pack berries. Precooling by submerging the product in cold water or passing through a spray has not been used except during cold-packing of strawberries and with some of the leafy vegetables such as carrots, turnips, and cabbage.

Portable mechanical refrigeration units, which are mounted on trucks and have a refrigeration capacity of approximately 40 tons, have been used to a limited extent. These units are driven up to the door of a loaded car, and two canvas ducts and a canvas cover are placed over the entire load so as to conduct the cold air through the load and then back over the evaporator coils. The general charge for this service is $25.00 per car for strawberries and Irish potatoes. The railroads have a standard charge of $5.00 per car for the precooling privilege, regardless of whether the car is set dry or iced for loading, when the car is moved under standard refrigeration. This makes a total charge of $30.00 per car for precooling with the portable mechanical refrigerator unit.

Almost all of the precooling in the Louisiana strawberry section is done with fans attached to the top bunker grill in each end of the car. The fans reverse the natural flow of air and utilize the ice in the bunkers as the refrigeration medium. The fans are 18 inches in diameter and either single-phase, 1725 r.p.m., or three-phase, 3450 r.p.m. The refrigeration capacity of this system is determined by the cooling surface of the ice and the volume of air passing over it. Strawberries with field temperatures below 70° F. can be precooled in from two to three hours. With a field temperature of from 70° to 80° F., precooling requires from two and one-half to four hours. With field temperatures above 80° F., precooling requires from three to five hours.

During the past three seasons (1938, 1939, 1940) precoolers using this method have been paid on a basis of $15.00 per car for an average temperature of 45° F. at the doorway, or $7.50 if they fail to get a 45° F. doorway average by the time the trains leave. During the 1940 season some shippers and buyers on various occasions asked for a precooled doorway temperature of 40° or 42° F. With these lower temperatures they reported a better carriage of tender berries and more ready sale.

FRUIT TEMPERATURES

The temperatures of strawberries delivered to the express cars on the various days tests were made varied from 64° F. to 84° F. These temperatures varied directly with the surrounding temperatures. Berries picked early in the morning and delivered by noon had a much lower temperature than those delivered later in the afternoon.

Picking, for the most part, was done by members of the grower's family, with transient white and black pickers providing the balance of labor needed. The number of pickers varied from one per 5,000 plants to one per 20,000 plants, with an average of one per 12,000 plants.

The strawberry patches were picked over, in a few cases, by 9 o'clock in the morning, but in many cases not until 12 o'clock noon. The strawberries were then carried to a packing shed or the house for sorting and packing. It was found that after packing, 96 per cent of all the growers stacked the crates in the shade before hauling them to town.

The time interval between picking and delivery to the railroad cars varied from three to five hours. The time interval between packing and delivery to the railroad cars varied from one to four hours.

The length of haul varied from one-half to seven miles. A few longer hauls were noted, but these were brought about by a desire to trade with a certain association.

Various types of horse-drawn and motor vehicles were employed in hauling to the railroads, with 53 per cent of the vehicles providing no protection from the sun and dust. The strawberries in the crates protected from the sun averaged 3½ degrees F. cooler than those not protected from the sun.

The heat of strawberries may be said to be composed of "field heat" and "heat of respiration." "Field heat" is commonly thought of as that amount of heat to be removed in order to reduce the temperature of the product from the temperature at which delivered to a storage temperature. "Heat of respiration" is the heat produced by strawberries as living substances and may be calculated by measuring the rate at which carbon dioxide is given off. The heat of respiration varies with each product and with the temperature level. By starting at 32° F. and continuing up to 80° F., Haller (4) found the heat given off by respiration of strawberries to be 12.8 degrees greater at 80° F. than at 32° F.

TABLE 1. Amount of heat of respiration in strawberries at various temperatures.

Temperature (degrees F.)	British thermal units of heat per ton of strawberries per 24 hours*	British thermal units of heat per ton of strawberries per hour
32	2,730-3,800	114-159
35	3,300	138
40	5,130-6,600	214-275
60	13,200-19,140	550-796
80	37,220-46,440	1,551-1,935

* The number of British thermal units was obtained (1) by assuming that the heat liberated by respiration is produced by the respiration of hexose sugar, and (2) by multiplying the milligrams of carbon dioxide produced per hour by each kilogram of respiring materials by the factor of 220.

REFRIGERATION

In cooling a carload of 736 crates of strawberries from 70° F. to 45° F. it is necessary to multiply the weight of fruit in pounds by the specific heat times the difference between the temperature at which the strawberries are delivered and the temperature to which the strawberries are to be cooled.

The unit of measurement of heat in the United States is the British thermal unit (B.T.U.), or the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. Most fruits and vegetables have a specific heat (7) between .85 and .95. Most authorities use .90 to .92 for strawberries. A typical car of strawberries will be taken as an example and calculated for the amount of refrigeration needed to precool it from 70° F. to 45° F. A crate of 24 pints of Louisiana strawberries by test weights contains 19 pounds of berries, with the crate and boxes weighing 5½ pounds. Thus

736 x 19 = 13,984 pounds of berries per car.
13,984 x (70°-45°) 25 x .91 = 318,136 B.T.U.

In melting, each pound of ice absorbs 144 B.T.U.; then $\frac{318.136}{144}$ = 2,209 pounds of ice needed to precool the berries from 70° F. to 45° F. The above is only for the cooling of the berries and does not include refrigeration required to remove the heat of respiration of the berries.

As shown by Haller (4), one ton of strawberries at 70° F. will give off an average of 1,208 B.T.U. per hour in heat of respiration and at 45° F. will give off an average of 329 B.T.U. per hour. The temperature of the berries, however, is not held at either of these points, but is gradually reduced from 70° to 45° F. If this car is precooled in two hours, then it is assumed that the B.T.U. produced by respiration is equal to the sum of that produced at 70° F. for one hour and at 45° F. for one hour, or a total of 1,537 B.T.U. per ton of strawberries. Therefore on 13,984 pounds, or 6.99 tons, of strawberries there are 10,743 B.T.U., or $\frac{10,743}{144}$ = 7.46 pounds of ice consumed by heat of respiration. This calculation has considered only the strawberries themselves; the boxes, crates, car stripping, and bracing must also be allowed for. One crate with its boxes weighs 5½ pounds, which means that the weight of the crates and boxes in a car of 736 crates is 4,048 pounds. The bracing and car stripping add another 476 pounds of lumber. Thus in an express carload of strawberries there is an additional cooling load of some 4,500 pounds of lumber. With a specific heat of lumber of approximately 0.60, an additional 470 pounds of ice are required to cool the crates, bracing, etc.

All types of refrigeration must allow for refrigeration loss, or heat infiltration through the walls and leakage around the openings. The generally accepted figure for heat leakage from a refrigerator car in average condition is 160 B.T.U. per hour per degree of difference between the outside and inside temperatures. Hence, in a two-hour period of precooling with an average difference of 19 degrees F. there is a heat loss of 6,080 B.T.U., which is equivalent to melting 42 pounds of ice.

Another factor that must be considered in precooling is the heat liberated by the fan motors. The two one-half horsepower, single-phase motors have a kilowatt input of .575 each. By experimental evaluation (8), the heat allowable for motors may be found by multiplying the kilowatt input times 3,412. On this basis, an additional 55 pounds of ice will be required to overcome the heat liberated by the two one-half horsepower fan motors.

A summary of the various items that must be considered in precooling this carload of strawberries shows:

	Lbs. of ice required
Strawberries, 13,984 pounds cooled from 70° to 45° F.	2,209
Strawberries, heat of respiration from 70° to 45° F.	75
Crates, boxes, car stripping, and bracing	470
Leakage or infiltration through walls and around openings	42
Refrigeration to overcome heat of two ½-H.P. fan motors	55
Total refrigeration during precooling	2,851

A check made of 17 test cars showed a close correlation between the above calculation and the actual results obtained. The average reduction in temperature throughout the 17 cars was 22.5 degrees F. and the average consumption of ice per car was 2,643 pounds.

EXPERIMENTAL WORK

The investigations on strawberry precooling covered in this report were conducted during the 1938, 1939, and 1940 seasons.

Tests were made on regular commercial shipments in standard express refrigerator cars and refrigerator trucks. No special equipment was installed in the refrigerator cars or trucks, except in some dry ice tests as will be described later.

The strawberries were delivered to the switch tracks, inspected, and loaded direct from truck to cars. The cars were then precooled and shipped standard refrigeration.

The precooling was accomplished by a fan placed in each end of the car at the top bunker grill. The fans were of either 16-, 18-, or 20-inch diameter with a rated free air delivery of 4,000 to 6,000 cubic feet of air per minute. The older fans were 14- and 18-blade, 18-inch diameter, 1750 r.p.m. The newer fans were 2- or 4-blade, 18-inch or 20-inch diameter, 3450 r.p.m. The top bunker grill was covered by a canvas baffle tacked to the ceiling, sides, and end of the car with car stripping. The fans were mounted in metal drum housings one-half inch larger in diameter than the fan and secured to the center of the canvas baffle; these drums in turn were suspended from the ceiling. Some precoolers hang the fan and drum on a wire trolley. Under that method, when precooling is finished, the fans and canvas baffle are pulled to the center of the car by a ⅜-inch rope and it is not necessary to get in over the load in order to remove the fans.

The fans reverse the natural circulation of air in that they blow the cold air over the load towards the center of the car. The air passes down through the load, under the false floor and up through the ice bunkers. Some operators use a canvas tunnel to conduct the air closer to the center of the car before allowing it to spread out.

The canvas baffle and precooling fans were placed in the cars before loading started. As soon as the car was loaded, the ice was barred down, from 200 to 400 pounds of salt was added, and the fans turned on. Cars in these tests were precooled in from 1 hour and 40 minutes to 4 hours, depending upon the temperature of strawberries at the start and temperatures of strawberries as tests progressed.

During precooling tests, temperature readings were taken with a thermocouple set. The points of the thermocouples were incased in very thin copper tubes 1/8 inch in diameter and pointed for easy insertion into the individual strawberries. That part of the point not in the berries was covered with several layers of tape to prevent the surrounding air from influencing the readings. Strawberry temperature readings were taken in crates midway between the two sides of the car in the top and bottom crates at the bunker, top and bottom crates six tiers from the bunker (or quarter length of the car), and top and bottom crates at the center of the car. Temperature of the air was taken at a point one foot from the fan if no tunnel was used. The thermocouple points were placed as the loading progressed, and the leads were run over the load and passed to the outside of the car through a thin protector between the door and padded doorjamb. The individual thermocouple leads were connected to a rotary selector switch and this in turn to a Leeds & Northrup potentiometer. This instrument is hand standardized, with an automatic reference-junction compensation so as to read Fahrenheit temperature degrees. Three different sets of thermocouple (iron, constantan) points were used during the tests and each was calibrated with a known standard thermometer and corrections applied to observed readings. Readings were made at 15-minute intervals with the thermocouple set during precooling. Temperatures of strawberries in top and bottom crates at the doorway were taken at the end of the precooling period with fruit thermometers. These latter temperatures were checked with the inspectors' readings for this location, as this is the temperature shown on the inspection ticket for the car.

Air temperatures in transit were secured on a few cars with Ryan recording thermometers. In two instances an extension type of dial thermometer was used. An attendant went with the car and made readings at each stop.

Arrival Conditions of Strawberries

The destination of each car is seldom known until after the strawberry auction which is held in Hammond each night during the strawberry season. When the destination of the test cars was learned, telegrams were sent and the cars were inspected for temperature and conditions of strawberries on arrival at the markets. The inspections were made either by regularly employed inspectors of the government or by inspectors of commercial inspection agencies.

A study of the records of the express company and of arrival conditions of the strawberries at markets showed that the number of complaints has decreased each year since 1937. Damage claims of one type or another were filed against 7.2 per cent of the cars in 1937, amounting to $63,173.12; this was reduced to 3.5 per cent of the cars in 1938, amounting to $40,525.23; and to 3.2 per cent in 1939, amounting to $39,340.22. These claims often are not filed until several months after delivery, and complete records are not available for the 1940 crop.

Table 2 shows in tabular form the types and amounts of these claims as filed. Some small number will be paid as justifiable, others compromised, and some will be dropped. However, each constitutes an expense to the express company for investigation and therefore is an item to be counted in arriving at the express rate.

New York and vicinity wants a 48- to 50-hour delivery, so as to get the berries on the market from eight to ten o'clock on the second evening after shipment. The railroad does not guarantee

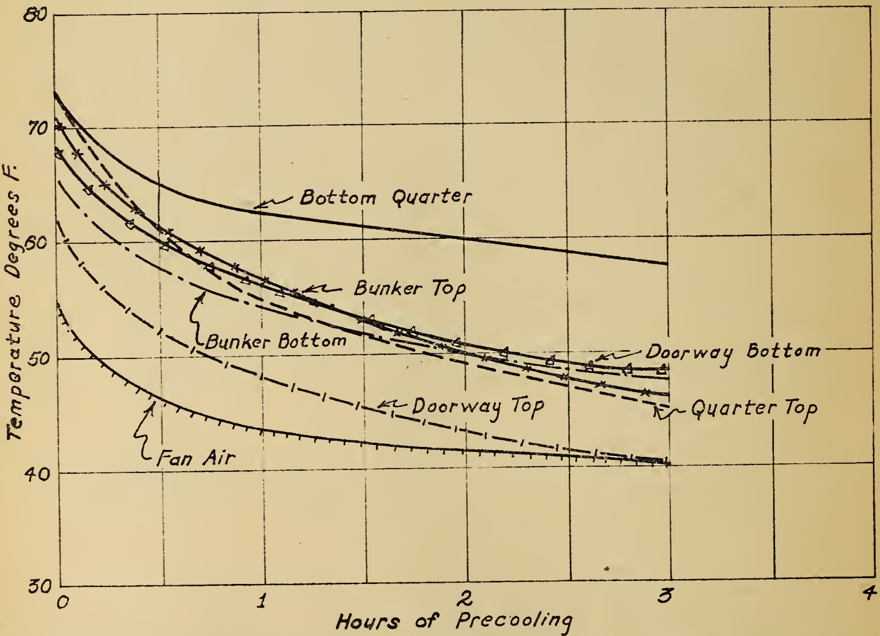

Fig. 1.—Strawberry and air temperature during precooling in express car N.R.C. 798 at Ponchatoula, La., April 15, 1939. Four hundred pounds of Grade No. 2 salt and 3000 pounds of ice were used in precooling. Car was shipped to New York City and was in transit 65 hours. New York City inspection showed few soft and decayed berries; less than 1 per cent soft and less than 1 per cent decayed. Average New York City temperatures showed berries in the top crates 39.5° F. and in the bottom crates 36° F.

TABLE 2. Number of cars and damage claims filed in 1939*

Town	No. cars shipped to each point	CAUSES TO WHICH DAMAGES ATTRIBUTED IN CLAIMS								
		Delays	Load shifted	Defective equipment	Improper refrigeration	Over-ripe	Frozen fruit	Salt	Delays in diverting	Delay breakdown
Boston	130				5 (3-R) $1598.02				1 $ 236.64	
Buffalo	45			1 $ 701.00	1 (1-R) $ 352.75					
Chicago	423						2 $192.00	2 $136.01		1 $ 189.15
Detroit	151	1 $ 291.70								
Montreal	29			3 $ 1088.48			1 $348.74			1 $ 475.44
Newark	21	2 $ 599.27		1 $ 858.68						
New York	159	8 $3612.81		17 (9-R) $ 6154.12	9 (3-R) (W) $3108.66				1 $ 474.24	
Philadelphia ...	81			16 (9-R) $ 6965.06	1 (1-R) $ 358.56				1 $ 324.92 (5 days) 1 $ 393.72	
Pittsburg	68		2 $346.02	1 $ 348.80		2 $563.91				
Rochester	18								2 $ 687.87	
Cincinnati	87									1 $ 153.55
Sioux Falls	18			1 (1-R) $ 110.40	1 $ 73.60	1 $110.40				
Total Damage .		$4503.78	$346.02	$16.126.54	$5491.59	$674.31	$540.74	$136.01	$2117.37	$1089.34

*Number in upper left hand corner of each square is number of cars; figure below is damage claim.
R = Rains during picking or on previous day.
W = Six cars picked and loaded at temperatures above 80° F.

such a schedule, and a 55- to 60-hour delivery often results in the berries being held over until the following day.

In checking the date of shipment and weather conditions against the claims, some significant facts are found. Sixteen claims were filed for improper refrigeration, with 14 from New York and vicinity. A further check on these 16 cars shows that 8 were picked during rainy weather when the berries are very tender and 6 were picked on days with temperatures above 80° F. Three claims for overripe, poor-condition fruit were filed. A check on these three cars shows picking was done during or immediately after heavy rains when temperatures were above 80° F. and the berries were soft and tender.

Too much refrigeration or frozen berries were involved in three claims. One car arrived in Montreal when the daylight temperature there was 35° F.

The value of claims charging insufficient refrigeration in 1939 was slightly more than 10 times that of claims made on frozen berries. It would therefore seem that a precooling temperature

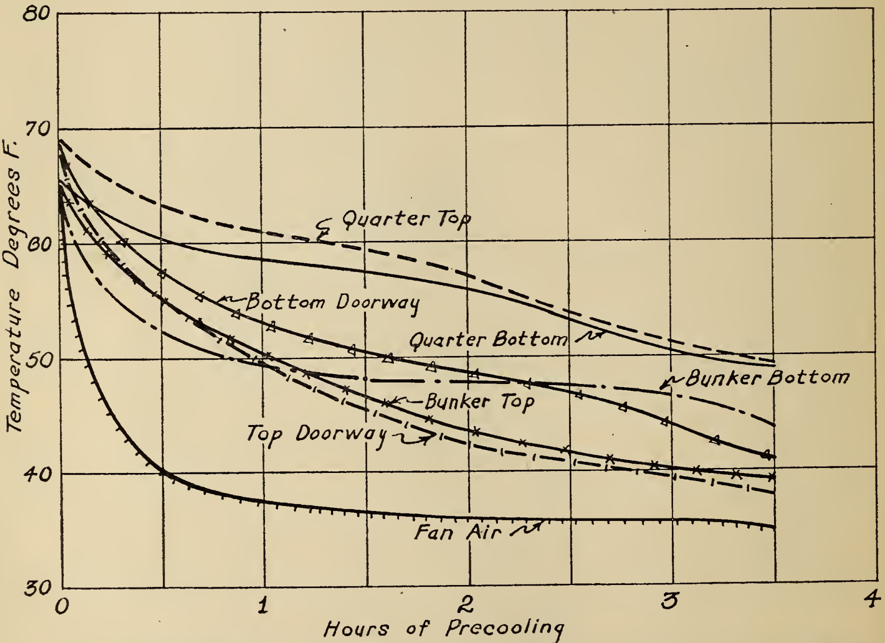

Fig. 2.—Precooling of Strawberries in express car Penn. 2728 at Ponchatoula, La., April 25, 1939. Four hundred (400) pounds of Grade A salt and 3600 pounds of water ice were used in precooling. Car was shipped to Montreal, Canada, and was in transit 64 hours. Montreal inspection showed 12 per cent cups with one to three moldy berries per cup, balance firm and ripe. Average Montreal temperatures showed berries in top crates 38° F. and in bottom crates 34° F.

lower than the present 45° F. would aid in reducing the claims for not enough refrigeration.

No claims were filed on any test car in which the strawberries had been precooled to a doorway temperature of 38° to 42° F.

Of the 86 claims filed, 40 charged defective railroad equipment. Investigation of weather records showed that the berries in 19 of these 40 cars were picked during or immediately after heavy rains. Two cars were partly loaded, held over to complete the load, and shipped the second day. Two cars were shipped as "5 to 20 per cent defective, not over 85 per cent U.S. No. 1" during the first two days of the season. These same two cars were used on later dates without complaint, so it would seem that causes other than equipment were responsible for the damages. It should also be noted that 33 of the 40 defective-equipment claims were filed from New York and Philadelphia.

The temperatures of the berries in the various parts of the cars, hours in transit, and arrival conditions of the berries are shown for three representative cars by Figures 1, 2, and 3.

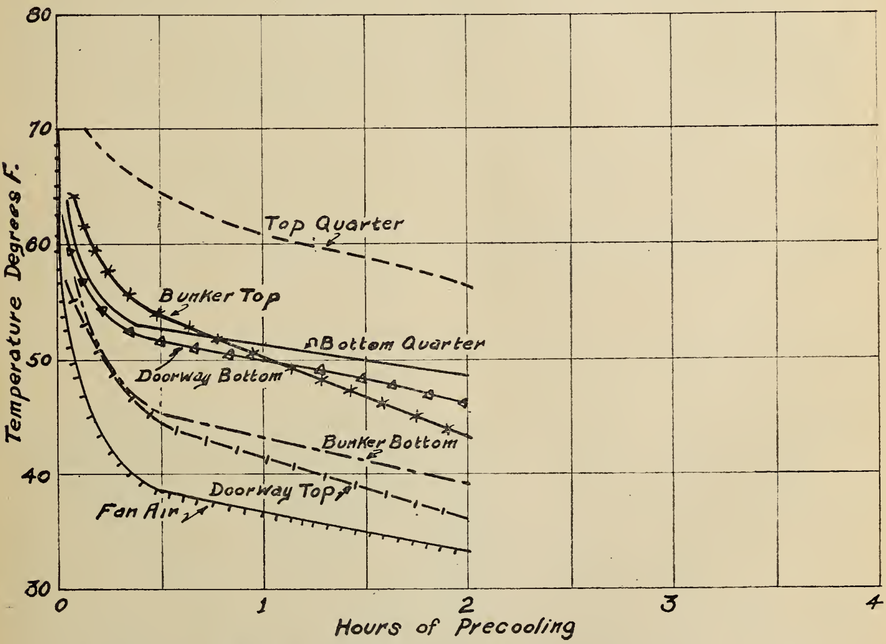

Fig. 3.—Precooling of strawberries in express car M. P. 3397 at Ponchatoula, La., April 14, 1939. Three hundred pounds of salt and 2100 pounds of ice were used in precooling. Car was shipped to Milwaukee and was in transit 39½ hours. Milwaukee inspection showed berries in all layers generally ripe and firm with no decay. Temperatures: doorway bottom, 38° F.; top, 44° F.; quarter bottom, 38° F.; top 44° F.; bunker bottom, 35° F.; top, 43° F.

Salt

During the 1938 precooling season it was observed that five different grades or sizes of salt were being used by the precoolers. Two damage claims for salt on top of the crates in the cars were filed against the Railway Express Company. Number 2 rock salt, very coarse, is the grade used by the railroads for pre-icing and at re-icing stations. In order to determine the best grade of salt for precooling, a test was made on a model refrigerator car, one-fourth size, using 3 per cent salt of the various grades with ice.

It is desirable to get an air blast as low as possible without freezing and as quickly as possible after starting the precooling fans. As is shown by Figure 4, the A and C grades of salt are preferred for their early low temperatures; in tests the temperatures obtained from these grades were still below those obtained from No. 1 and No. 2 rock salt at the end of two hours. For the 1939 season about 80 per cent of the salt used was of an A grade.

Salt on top of the crates inside of the cars more than likely is caused by precoolers turning on their fans before the salt has been added and thus drawing some of the fine salt through the fan as it is added. This was observed to be the case in one instance.

The general rule is to add 200 pounds of salt per car early in the season when the temperature of berries is below 65° F. Three hundred pounds of salt per car are used when berry temperatures are from 65° to 70° F. With berry temperatures above 80° F., 400 pounds of salt per car are used.

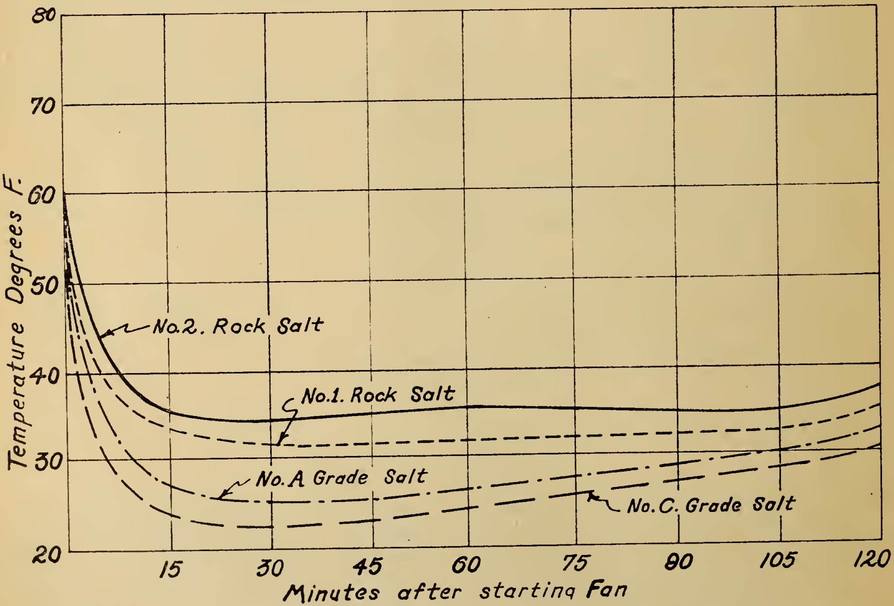

Fig. 4.—Air blast temperature, for four grades of salt on ice.

Dry Ice (Carbon Dioxide)

In laboratory tests with strawberries, Brooks and associates (2) found that carbon dioxide concentrations of 10 to 13 per cent had little effect on checking Rhizopus or Botrytis; 17 to 19 per cent carbon dioxide had a checking effect equivalent to a drop of 18 degrees Fahrenheit in temperature; and 23 per cent concentration of carbon dioxide completely checked all growth at lower temperatures. Slight injury to taste was noted in a few samples with higher concentrations over prolonged periods. With carload shipments, the same workers found that approximately 500 pounds of solid carbon dioxide would give concentrations of 22 per cent in the first few hours after closing the car. However, these concentrations fell off very rapidly to 2 per cent in 30 hours regardless of the original amount of solid carbon dioxide used.

TABLE 3. Per cent concentration of carbon dioxide in four test cars.

Pounds carbon dioxide	Hours after carbon dioxide added to car											
	3%	6%	8%	12%	14%	18%	20%	24%	28%	30%	32%	48%
283	9.5	..	6	..	5	..	..	..	..	5	..	..
319	..	..	13-17	..	10	..	5	..	2	..	..	..
798	30	..	..	17	..	..	..	8	..	..	..	2
1084	22	15	..	..	..	10	..	6	..	..	2	..

In a test made by Brooks (2) it was found that a car containing no carbon dioxide showed two and one-half times more Botrytis and 20 per cent more Rhizopus at destination than did the carbon dioxide cars. The carbon dioxide cars also showed 26 per cent fewer berries too soft for marketing as compared to cars with no carbon dioxide.

Several arrangements have been tried in an effort to obtain uniform distribution of the carbon dioxide throughout the car. Placing the solid carbon dioxide in 50-pound cakes in the water ice after precooling is a doubtful procedure. The possible concentration may be cut down materially by the volatile carbon dioxide uniting with the water from the melting ice when the two are placed in direct contact with each other.

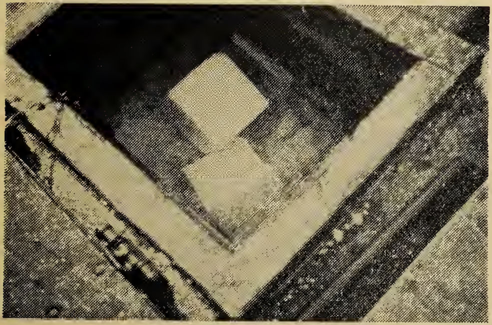

Fig. 5.—Two 50-pound cakes of dry ice added to each hatch with water ice.

Dry ice (carbon dioxide, or CO_2) was used experimentally on two cars in 1938 and three cars in 1939 shipped from the Louisiana strawberry district to northeastern markets. The carbon dioxide was used in addition to the water ice in an effort to reduce deterioration and, if possible, ship through to destination without re-icing.

Two cars were checked during precooling on April 4, 1938, and shipped—one under water ice plus 1000 pounds of dry ice in ceiling bunkers (REX 1162, Figure 7) and in re-icing in transit, and the other with standard refrigeration and re-icing in transit. A third car (REX 222, Figure 7) was checked during precooling on April 16, 1938. After precooling was done, 600 pounds of dry ice were placed in special auxiliary bunkers inside the water ice bunkers with 4200 pounds of water ice. This car was sealed and shipped to New York City. The results on this test are shown in Table 4.

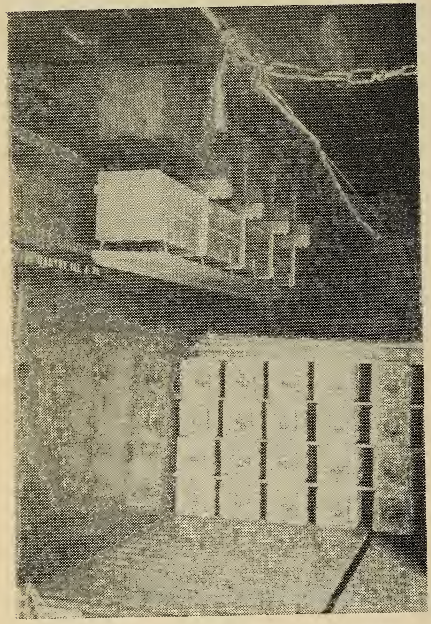
Fig. 6.—Special dry ice bunkers attached to ceiling of car.

From a study of Table 4 it will be noted that the cars with dry ice plus water ice were shipped through without re-icing in transit and arrived in fair condition. The car in which 1,000 pounds of dry ice were used, with water ice, arrived in somewhat better condition than the car using only 600 pounds of dry ice plus water ice.

In April, 1939, three identical refrigerator cars which had just been repaired were selected for another test with dry ice. These cars were pre-iced, loaded at the same time, and then precooled. One car was shipped under standard refrigeration (no dry ice), and the second and third with 400 pounds of dry ice per car. The results of this test are shown in Table 5.

It will be noted from a study of Table 5 that one car with dry ice plus water ice arrived at market with a lower temperature and with berries in better condition than a check car, without dry ice, which was in transit the same number of hours.

TABLE 4. Loading, transit, and arrival conditions on three test cars in 1938.

Conditions	REX 1162	NRC 484	REX 222
Refrigerant	1000 lbs. CO_2, water ice, car sealed.	Water ice — re-icing to destination.	600 lbs. CO_2, water ice, car sealed.
Temperature (degrees F.) of berries at car	62	62	82
Precooled temperature (degrees F.)			
Bunker	41	41.5	48
Quarter	50	48	56
Doorway	39	40	44
Temperature at destination (degrees F.)	37 to 40		
	36 to 42*	32 to 37	37 to 47
Time in transit	42 hours to Cleveland, Ohio	57 hours to Hartford, Conn.	55 hours to New York City, N. Y.
Arrival conditions	Free from mold growth, firmer condition, and absence of the usual running.	Berries firm, practically no decay.	Decay 0 to 7%, average 2%, gray mold rot, and Rhizopus in early and semi-advanced stages.

*A water ice car that arrived in Cleveland from the Louisiana district at the same time as REX 1162; this car, however, was not checked during precooling.

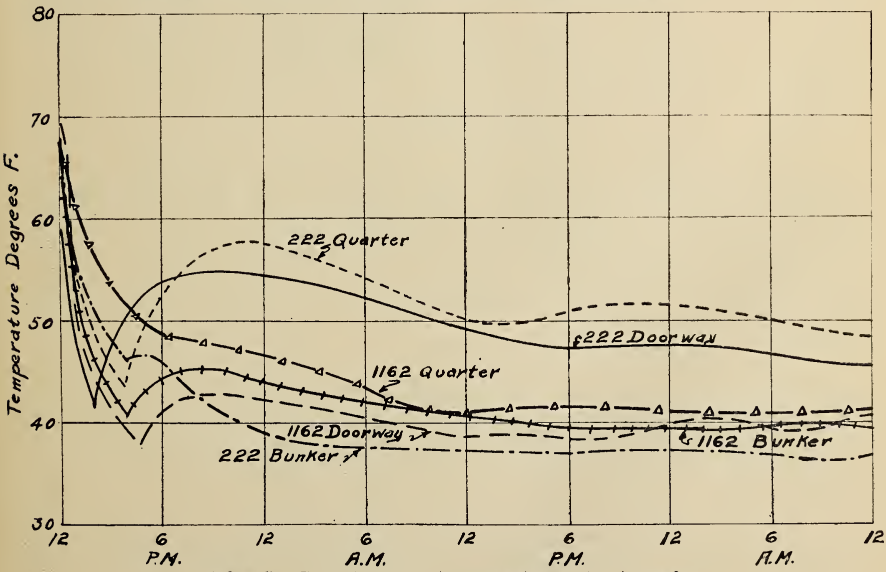

Fig. 7.—Dry ice car temperatures in transit.

TABLE 5. Loading, transit, and arrival conditions of three test cars in 1939.

Conditions	REX 1146	REX 1157	REX 1106
Ice and salt before precooling.	14,175 lbs. ice, 3% salt.	14,175 lbs. ice, 3% salt.	15,000 lbs. ice, 3% salt.
Ice after precooling	2400 lbs.	2400 lbs.	4200 lbs.
Dry ice	400 lbs. (ceiling bunkers)	400 lbs. (in with water ice)	None
Ice in transit	3600 lbs., 3% salt	2600 lbs.	1800 lbs., 3% salt
Destination	Montreal	Pittsburg	Detroit
Hours in transit	61	40	40
Precooled temperature (degrees F.)			
Doorway	44	42	44.5
Quarter	50	45	56
Bunker	45	39	51
Temperature at destination (degrees F.)	33 to 35	34 to 42	38 to 42
Arrival conditions	Firm ripe to ripe, mostly firm ripe. Less than 2% decay.	Berries generally firm, only occasionally berry soft and an occasional berry with leather rot, and that only irregularly in an occasional cup. On whole, better than average load.	Generally firm in most crates, less than 1 to 2% soft, few crates 3 to 4% soft, occasionally 5 to 6% soft. In most crates 2 to 3% decay, few crates 1%, occasionally 4 to 5%.

Truck Shipments

Truck shipments of strawberries from the Louisiana section increased markedly during the 1940 season with shipments being made to Dallas, Fort Worth, Little Rock, Kansas City, St. Louis, Colorado Springs, Chicago, Detroit, and Canadian points. Shipments of strawberries by truck in 1940 from Louisiana equalled 149 carloads, or 6.29 per cent of the total number of berries shipped.

Strawberries were trucked without precooling to Little Rock, Dallas, and Fort Worth. Refrigeration for these hauls was furnished by 500 to 800 pounds of ice and 10 per cent salt, the brine formed by the ice and salt being forced through a series of coils. A fan back of the coils forced a cold blast of air through the loaded truck.

A truckload of mixed vegetables and 252 crates of strawberries shipped to Kansas City arrived in very poor condition with moldy

TABLE 6. The length of haul, hours in transit, and arrival condition of strawberries transported by truck under various types of refrigeration.

	Approx. number of miles	Hours in transit	Number of crates	REFRIGERATION			TEMPERATURES (Degrees F.)					Delivery Remarks
				Type	Ice	Salt	Precooled	Outside	Berries	Berries after precooling	Berries	
Ponchatoula to: Fowler, Colo.	1300	49	601	2 coils 2 pumps 2 fans	1000	200	Yes	84	74	41	40	Berries showing effects of rainy weather. Fairly good condition.
Hammond to: St. Louis, Mo.	675	30	392	Ethyl chloride	None	None	Yes	70	65	35		Sold readily. Inspector did not get.
Ponchatoula to: Chicago, Ill.	900	36	444	1 coil 1 pump 1 fan	550	60	Yes	78	72	36	40	No decay, berries fresh, firm and bright.
Ponchatoula to: Chicago, Ill.*	900	36	420	1 coil 1 pump 1 fan	600	75	Yes	70	65	38	40	Sold readily.*
Ponchatoula to: Detroit, Mich.†	1050	56	392	Air blast through cold water spray.	800	20	Yes	84	74	44	40	Quality fair. Refrigeration O. K.
Ponchatoula to: Kansas City‡	800	36	252	‡	1000	None	No	86	80		54	Very moldy, poor condition. No ventilation.

*Inspected 12 hours after arrival in Chicago while last 20 crates were being sold. "Dark colored and slightly dull, 3 to 10% of berries soft and bleeding; most crates no decay, many 1 to 3% gray mold rot."

† Load arrived in Detroit on Sunday morning and was held over until Monday morning before opening.

‡ Ice in front ice bunker and cakes of ice chipped up on cabbage, eggplants and white squash. Berries made up only half of load.

berries. This truckload was not precooled, refrigeration in transit being furnished by approximately 1000 pounds of ice distributed through the vegetables and in a metal bunker. The moldy berries may no doubt be traced to the close stacking of the crates and lack of proper ventilation.

Other truckloads were precooled to an average of 36° to 41° F., arriving at markets 36 to 50 hours after shipping with an average temperature of from 38° to 43° F. A portable mechanical refrigeration unit mounted on a truck and having a refrigeration capacity of approximately 40 tons was used for precooling the truckloads of strawberries. The general charge for this service was $12.50 per truckload. Ice and salt were used in the trucks with pumps and fans circulating the cold air. A direct expansion refrigeration system was also used to furnish refrigeration needed in transit.

The shipment of strawberries by trucks allows a more flexible and wider distribution than is obtained by express. Some of the comments obtained in a canvass of commission merchants were:

"Truck berries did not carry quite as well as those received by express, but we were able to handle and market the berries to a good advantage."

"The berries in the front end of the truck were in good shape and properly refrigerated, while those in the rear of the truck showed more ripeness and shaking up."

In the study of truck shipments the data from six representative trucks is concisely shown by Table 6.

SUMMARY AND RECOMMENDATIONS

The investigations on strawberry precooling covered in this report were conducted during the 1938, 1939, and 1940 seasons. Precooling in the test cars was accomplished by fans placed in each end of the car at the top bunker grill.

Virtually all of the express carload shipments of strawberries from Louisiana are precooled, owing to a substantial increase in price for such berries, plus the fact that less loss due to decay in transit is sustained when berries are precooled. Almost all of the precooling in the Louisiana strawberry section is done with fans attached to the top bunker grill at each end of the car. However, portable mechanical refrigeration units, which are mounted on trucks and have a refrigeration capacity of 40 tons, have been used to a limited extent.

The more advanced the berries are in color and maturity, at the time of picking, the greater is the need for precooling. The ripening process continues after harvesting and may even be accelerated, depending on surrounding temperatures.

The Louisiana State Market Commission requires a maximum temperature of 45° F. in order for a car to be listed as "precooled." A precooled temperature of 45° F. is satisfactory early in the season; but as the weather becomes warmer and rainy weather results in tender berries, a precooled temperature of 38° to 40° F. is recommended.

A precooled temperature lower than the 45° F. now used would aid in reducing claims for insufficient refrigeration. No claims were filed on any test car in which the strawberries had been precooled to a doorway temperature of 38° to 42° F.

Refrigerator cars are often opened as early as nine o'clock in the morning for loading and not finished until four in the afternoon. This allows the car to warm up from 40° F. to 65° or 70° by the time loading is finished. Each association should endeavor to finish the first car started as quickly as possible.

It is doubtful if the use of salt for pre-icing has any value when the refrigerator car is left open for several hours in loading.

Labeling of crates should be performed at home, as this slows up loading and puts an extra man in the car.

Refrigerator-car loading crews should be experienced and closely supervised.

In order to secure a more uniform temperature throughout the car, the air delivery tube on the precooling fan should not extend beyond the fourth tier from the bunker.

Precooling fans should be turned off when salt is being added to the car, since there is danger of fine salt being drawn through the fans and deposited on crates of berries when salt is added with the fans in operation.

A-grade salt should be used for precooling periods of one to four hours.

By utilizing a combination of water ice and dry ice, a car may be shipped to distant points without stopping for re-icing in transit.

Satisfactory shipment of strawberries by motor-refrigerated trucks to distant markets is now possible. More attention, however, needs to be given to the bracing and refrigeration of the tiers of crates in the rear of the refrigeration trucks.

Truckloads of berries precooled to 36° to 41° F. with portable mechanical refrigeration units arrived at markets 36 to 50 hours after shipping with temperatures of from 38° to 43° F. A direct expansion refrigeration system was used in some of these trucks to furnish refrigeration needed in transit. In other trucks the refrigeration in transit was provided by the use of pumps and fans circulating cold air over ice and salt.

Shipment of berries by trucks allows a more flexible and wider distribution than is obtained by railway express.

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Precooling and Drying of Washed Irish Potatoes

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PRECOOLING AND DRYING OF WASHED IRISH POTATOES

by

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INTRODUCTION

The Irish potato crop has become one of the most valuable and extensively grown of all vegetable crops of Louisiana, and large quantities of Irish potatoes are shipped to northern markets every year. The average annual production for Louisiana during the five-year period 1929-1933 was 2,138,400 bushels.

Due to the increasing demand and premium paid by the market for washed potatoes, approximately 60 per cent of the Louisiana potatoes are washed before shipping. The washing, even if accomplished under the best conditions commercially feasible, is likely to be accompanied by considerably more loss due to decay than would occur if the potatoes were not washed. This predisposition to decay is caused by the thorough inoculation of the entire surface which each potato receives when immersed in water laden with decay organisms that may come in with the soil or with potatoes that were already infected in the field.

To reduce this decay after washing, the practice of precooling potatoes was developed. This removes the field heat and surplus moisture from the washed tubers.

There has been considerable work done on the development and growth of Fusaria rots of the Irish potato in the pure culture form with respect to temperature and relative humidity. Studies have also been made on desirable storage conditions, but there has been very little attempt to study the benefits and efficiencies of the various types of precooling units and the carrying qualities of the tubers after being cooled and dried by the various methods.

The object of this work was to study precooling and drying methods of Louisiana washed potatoes, to determine the best precooling temperature for shipment, and to work out a low-cost economical method of drying and cooling potatoes.

REVIEW OF LITERATURE

Plant pathologists are well aware of the fact that certain parasitic organisms which injure crops at one temperature will remain practically harmless at another. Properly regulated low temperatures for cold storage are fully recognized as important in checking the progress of parasitic diseases (1).

In 1938, Decker of Kansas (3) investigated new methods of shipping Kaw Valley Irish potatoes in an effort to decrease the decay in transit. Prior to this time cars arriving at the market sometimes had as much as 40 to 60 per cent wet or spotted sacks. Ten per cent wet sacks was not considered a bad car.

In June, 1938, four test cars were loaded with Kaw Valley U. S. No. 1 potatoes and shipped to Houston, Texas. Two of the cars were precooled by the Shippers Precooling Service, a mechanical refrigeration unit being used. One of these cars was iced after precooling and shipped with the vents closed. The other car was precooled and shipped under standard ventilation without ice. The third car was only initially iced and delivered with vents closed. The fourth car received no treatment at all and was shipped standard ventilation.

Conditions of potatoes when inspected at destination showed that precooling and then shipping under standard ventilation was the best method, as icing the car after precooling caused the arrival temperature to be somewhat low and caused the potatoes to sweat and become moist after the car was opened. However, both cars had no decay in transit. When the car of potatoes was initially iced and shipped without precooling and with the vents closed, arrival conditions were found to be good, although some sacks showed wet spots. The untreated car showed some soft potatoes and damp sacks upon arrival at destination.

Recent investigation on the precooling and drying of washed potatoes in Florida by Wright, Hukill, and Gorman (9) pointed out the increasing demand for washed potatoes on the market, which, in turn, increased the demand for methods of removing the field heat and drying the excess moisture from the surface of the tubers before shipping. Heavy decay in transit was noted before precooling methods were used on potatoes prior to shipping. Two methods of precooling, or "conditioning," were studied: the bunker-fan blower method and the mechanical refrigerating method; the first utilizing ice in the bunkers to give a lower temperature to circulating air, and the latter using a mechanical refrigerating unit mounted on a truck and circulating air through the doorway. Somewhat lower temperature reduction was obtained by the mechanical method but a greater evaporation of moisture was obtained by the fan method. After fifteen hours, the car cooled by the fans had a lower temperature than a similar car in which the mechanical unit for cooling was used. Results from drying tests showed that potatoes left in the open to dry lost .46 pounds per bushel, while those in crates blown with fans lost from .40 to .45 pounds per bushel. Potatoes dried by the mechanical unit lost .25 pounds per bushel.

GENERAL PROCEDURE

Because of the loss of potatoes in transit from rot infection after washing, various methods for cooling and drying potatoes are used. Observations of these various types were made. Only a casual observation was made on some of the methods as the exceedingly low efficiency was obvious from the operation.

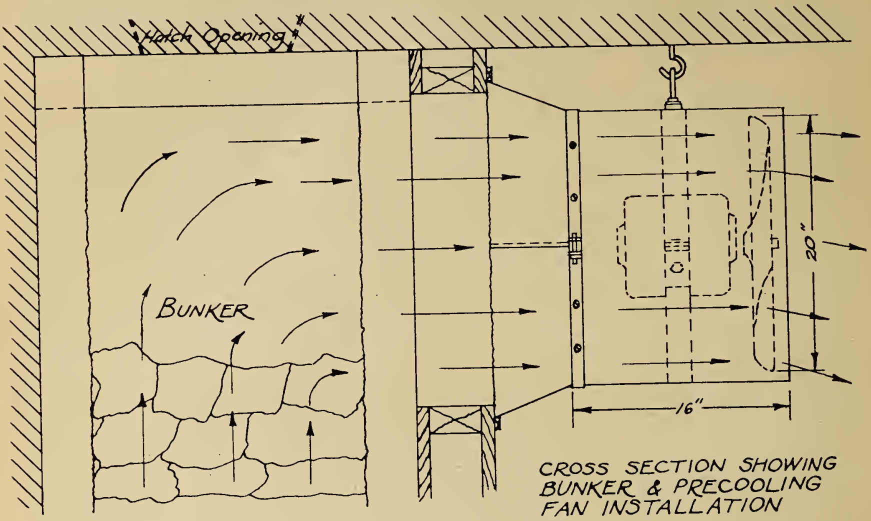
During precooling tests, temperature readings were taken with a thermocouple set. Potato temperatures were taken from two sacks next to the bunker, from two sacks six rows from the bunker (or quarter length of the car), and from two sacks at the center of the car. The temperature of the air was taken at a point five feet in front of the fan. Leads from the thermocouples were run over the load and passed to the outside of the car, between the door and the padded doorjamb. The individual thermocouple leads were connected to a rotary selector switch and this in turn was coupled to a Leeds & Northrup potentiometer. This instrument is hand standardized, having an automatic reference junction compensation so as to read Fahrenheit temperature degrees. Readings were made at 15-minute intervals with the thermocouple set during precooling.

When using the bunker fans for cooling and drying, the amount of ice put into the bunker at the start of precooling was noted and a check was made of the amount left, if any, at the end of the operation.

It was desirable to know the arrival condition of certain test cars at the destination. To do this a copy of the inspector's report on condition of potatoes on arrival was obtained.

In the designing of a low-cost bunker-fan blower unit for the cooling and drying of Irish potatoes, two such units were constructed in the laboratory for testing motor speeds and various types of fan blades. Each unit was made to discharge into a circular, sealed, galvanized duct, 10 feet long, having a diameter the same as the fan blade tested. An arrangement was made to completely block off the discharge duct to obtain the maximum static pressure developed under no discharge conditions. The static pressure gauge was located five feet in front of the fan, in the top of the discharge duct. The velocity pressure was taken at the end of the discharge duct with an Alnor velometer, using a No. 0.2220 tip. From these velocities the capacity of the combination blade and motor speed was calculated by using the formula, $Q = A \times V$, where Q is the quantity of air delivered in cubic feet per minute, A is the cross sectional area of the discharge duct in square feet, and V is the average velocity of air flowing in feet per minute.

The electric motors used were two ½-horsepower, 110-volt capacitor type, having speeds of 1750 r.p.m. and 3450 r.p.m., respectively. Seven types of blades of various pitches were used in the tests. These included both two-blade airplane type and four-blade propeller type fans, having diameters of 18 inches and 19 inches, respectively. The complete bunker-fan blower unit with canvas bunker cover is shown in Figures 1 and 2.



CROSS SECTION SHOWING BUNKER & PRECOOLING FAN INSTALLATION

Figure 1

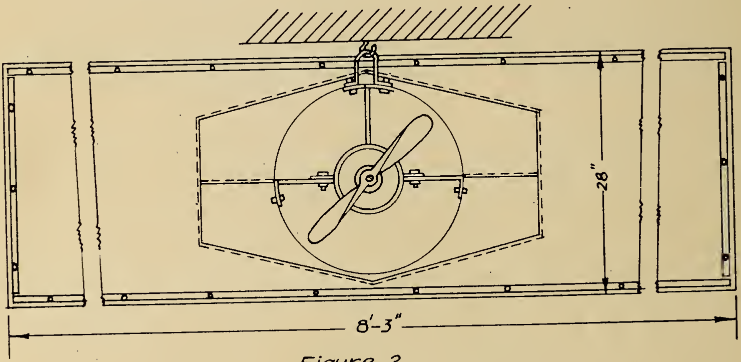


Figure 2
FRONT VIEW OF FAN & BAFFLE

The amount of ice to be used in the ice bunker when precooling and drying with bunker-fan blowers was calculated from the total heat loss of the car during precooling. The average temperature reduction of nine cars of Irish potatoes that were precooled and shipped to market, without loss due to decay, was used as the basis for precooling calculations.

In determining the moisture loss from potatoes during precooling, sacks in the desired locations were weighed before and after precooling. In the case of fans blowing while the car was being loaded, these sacks were weighed before the fans were turned on and weighed again before and after cooling.

When the mechanical precooling unit was used, the sacks were weighed before and after precooling, the same as with the bunker-fan blower units.

A check on precooling moisture loss was made on the platform by weighing three freshly washed sacks of potatoes. One sack was spread out on the platform to dry, the second was dumped into two slatted crates, and the third sack was left standing on the platform in the shade. These sacks were weighed again four hours later to determine the moisture loss in each.

EARLY INVESTIGATIONS

Harvesting

Investigation showed that the date of harvesting was affected to a marked degree by the prices of potatoes prevailing during or preceding the usual period of digging. The desire of the grower to obtain the higher prices serves as an incentive to harvest the potatoes early, and before they have reached maximum size and maturity. The general result of such action is to prevent the normal yield of the crop, and subsequently it brings unsatisfactory results in dollars and cents. There are seasons, however, in which the market price falls so rapidly after shipments become heavy that the grower who harvests his crop early actually receives more money for his small yield than he would have received from a larger crop later in the season. Each grower must decide for himself whether he is justified in taking the smaller yield in order to market his crop early.

One objection to the early harvesting is that the tubers are not mature and are easily bruised and skinned while passing over the grader or through the washer.

The potato crop is harvested with a common middle-breaker plow, and in the majority of cases this plow is pulled by either mules or a tractor; however, at the present time elevating diggers are being used in a few fields.

A check made in one field where a middle-breaker pulled by a pair of mules was used to dig potatoes in clay soil showed that for 100 feet of row length, 6.25 pounds of potatoes were cut by digging and 4.7 pounds were left in the field by the pickers. A similar check on a mechanical picker in sandy loam soil showed no cuts and no potatoes left in the field by the picker. The mechanical digger did a better job of removing the excess soil from the potatoes, and left them on top of the row where they could easily be seen by the pickers.

Both crates and sacks are used in transporting the potatoes from the field to the grading and washing shed. The crates are preferred by the growers, and checks made on bruised tubers arriving at the shed showed that there was less bruising and skinning when the crates were used. The reason sacks are used for this process is that the cost of sacks varies from 7 to 9 cents each, while crates range from 15 to 25 cents each, depending upon the weight and construction.

Washing and Grading

The process of washing potatoes before shipping has developed gradually in the past six years until today practically all potatoes shipped out of the state are washed. This process developed as the market demand for clean stock increased to such an extent that not only a premium price of 10 to 20 cents per sack was offered, but a ready sale for the washed potatoes over the unwashed was insured. The difference in premium depends upon the weather conditions, as rainy weather causes the unwashed potatoes to be very dirty, thereby increasing the premium for washed tubers.

Many of the early washers consisted of tubs and pressure hoses used to remove some of the heavy soil from the potatoes. From this some growers developed their own washers while others had manufactured washers installed.

The use of official grading standards and the Federal-State Inspection Service facilitates transactions between shippers and distant buyers, furnishes a basis for contract sales, and discourages rejection of shipments at the markets without a just cause. An inspection certificate showing detailed information concerning the shipment is an aid in settling any damage claim with the transportation company. Growers are encouraged to produce good quality, and shippers, through the use of official grading, standards, and inspection invoices, are encouraged to pack properly.

In order to meet the inspection, the shipper has his potatoes carefully checked and all bad potatoes removed before sacking. Careful selection and picking ensure a shipper against loss from decay in transit.

Packages

The 100-pound-capacity burlap sack is the universally used container in marketing the Louisiana Irish potato. Shrinkage up to 2 per cent, between shipping point and destination, is usually recognized in trade as likely to occur under average conditions. Practically all shippers pack slightly more than 100 pounds in a sack to prevent shrinkage from causing a shortage in weight at destination.

Car Loading

The method of arranging sacks in the cars varies in different states. The common practice in Louisiana is to place three sacks standing on end and two more lying flat on top of them. The bottom of the first sack next to the car wall is placed about six inches from the wall. This allows space for air circulation. The last sacks, loaded in the doorway, are placed horizontally, forming a wedge to prevent any shifting of the load in transit. Louisiana shippers prefer this method of loading as it simplifies the counting of the sacks, especially if a recount is necessary after the car has been loaded.

Methods of Cooling and Drying Potatoes

To prevent the growth of decay organisms in tubers during shipment, several methods have been used to remove the field heat and reduce the temperature of the potatoes before shipping. This practice of precooling has been used for some years by fruit shippers of the western and southern states in transporting various fruits to eastern markets.

Precooling may be termed a form of refrigeration used for the rapid removal of the field heat from a product before shipping. In the case of fruit, this is done particularly to reduce the temperature to a point where ripening is materially arrested and mold growth prevented. This reduction in temperature will vary with the variety of product, method of shipping, and type of container. For best results, precooling should be accomplished as soon as possible after loading.

In addition to removing the field heat of washed potatoes, precooling also removes the surplus moisture from the surface of the potatoes and tends to dry out the skin bruises and any cuts that may be present.

The drying of the potato after washing is as important as is the reduction in temperature. The excess moisture, if left on the surface, aids in the growth of three types of Fusaria fungi attacking Irish potatoes. This was pointed out in early studies by Smith and Swingle (8). The importance of drying the tubers after washing was further pointed out by Wright (9), who wrapped a crate in paper to prevent the drying of surface moisture. This crate was shipped along with two carloads of potatoes that had been dried, and no decay was found at destination in either car except in the one wrapped crate, which contained 3 per cent bacterial soft rot.

A survey of the shipping points showed that several methods were being used to dry potatoes after washing. Some shippers used a reduction in temperature and others used an air blast at atmospheric temperatures. Two of the methods in use showed sound economical results, while other methods proved inefficient from an economical standpoint.

Portable mechanical refrigerating units having a refrigerating capacity of 40 tons and mounted on trucks were being used by several shippers in the state. To precool by this method, a truck bearing such a unit is driven up to the door of a loaded car and a canvas cover is placed over the load. Two canvas ducts leading from the car door to the unit are used to circulate the cold air through the load and back over the evaporator coils. This is continued for two hours and the general charge for the service is $25 per car of potatoes.

One shipper was found to be precooling with large 18-inch airplane blade fans having ¾-horsepower motors and turning 3450 r.p.m. This method consists of the use of portable fans at the top of the bunkers in each end of the car to reverse the natural air circulation by drawing the air upward through the ice bunkers and distributing it throughout the load. As the cold air comes in contact with the warm potatoes, the temperature of the air rises and enables it to absorb the excess moisture. This moisture is deposited on the ice as the air is recirculated through the bunker. This shipper had been using this method for some time and had successfully precooled and shipped approximately 400 cars of Irish potatoes.

CONSTRUCTION OF A LOW-COST PRECOOLING AND DRYING UNIT

It was found that when potatoes were cooled and dried by either the mechanical refrigeration trucks or the bunker-fan blowers, the decay in transit practically always ceased. It, then, was obvious that the shipper had to use one of these two methods to condition his washed potatoes, especially if he waited until late in the season to dig when the weather was warm or wet.

Owing to the extremely high cost of a mechanical refrigerating truck and the time necessary to cool a car of potatoes, the companies owning these trucks have been able to take care of only two or three of the larger shippers in the state. It is therefore necessary for other farmers to use some other desirable and economical means of cooling and drying their potatoes.

Another efficient method would be the use of bunker fans using ice in the car bunkers as a cooling medium for the circulating air. A design of such a unit was made in order that each shipper might have bunker fans made and used as an insurance against decay in transit.

Selection of Motors and Blades

In order to determine the most desirable and efficient type of motor speed and fan, seven combinations of fans and motors were tested, limiting the diameter of the fan blades to 20 inches, which is the approximate depth of bunker grill openings. The best combination was found to be a ½-horsepower, 3450 r.p.m. motor having an airplane blade 20 inches in diameter.[1] This unit showed a capacity of 4300 cubic feet per minute free air delivery. The larger the fan and motor, the greater the capacity, and so the shorter the time necessary to cool and dry a carload of potatoes; however, the first cost of the unit will increase with the size. When using an 18- to 20-inch fan and a 3450 r.p.m. motor, it is desirable to precool at least three hours.

Material Cost of Test Unit

The complete cost of a test unit constructed in the laboratory, exclusive of labor, was $33.25. Itemized, the cost was as follows:

Material	Cost
Fan collar complete	$1.45
Motor brace	0.45
Canvas bunker baffle	7.50
Motor, ½ h.p., 3450 r.p.m.	20.75
19-inch airplane fan blade	3.10
Total	$33.25

The constructed fan unit is shown in Figure 3. It is necessary to have a fan attached at the top of each bunker of the car.

Heat Losses and Refrigeration

A study of the temperature reduction of potatoes in properly precooled cars was used as a criterion for this work. The average temperature of potatoes at the beginning of precooling was found to be 74.5° F., and after cooling it was 57.3° F., showing 17.2 degrees reduction in temperature during the cooling process. The total number of B.T.U. removed from the potatoes and heat lost from the car during precooling was used to calculate the refrigeration necessary. Refrigeration is usually measured in terms of the standard ton or the quantity of heat (expressed in B.T.U.) required to melt a ton of pure ice at 32° F. into water at 32° F. Mechanical refrigeration capacity is expressed in tons per day, or a rate of heat removal equal to 288,000 B.T.U. per day, or 12,000 B.T.U. per hour.

In order to arrive at the total refrigeration necessary during precooling, all losses in excess of the sensible heat and heat of

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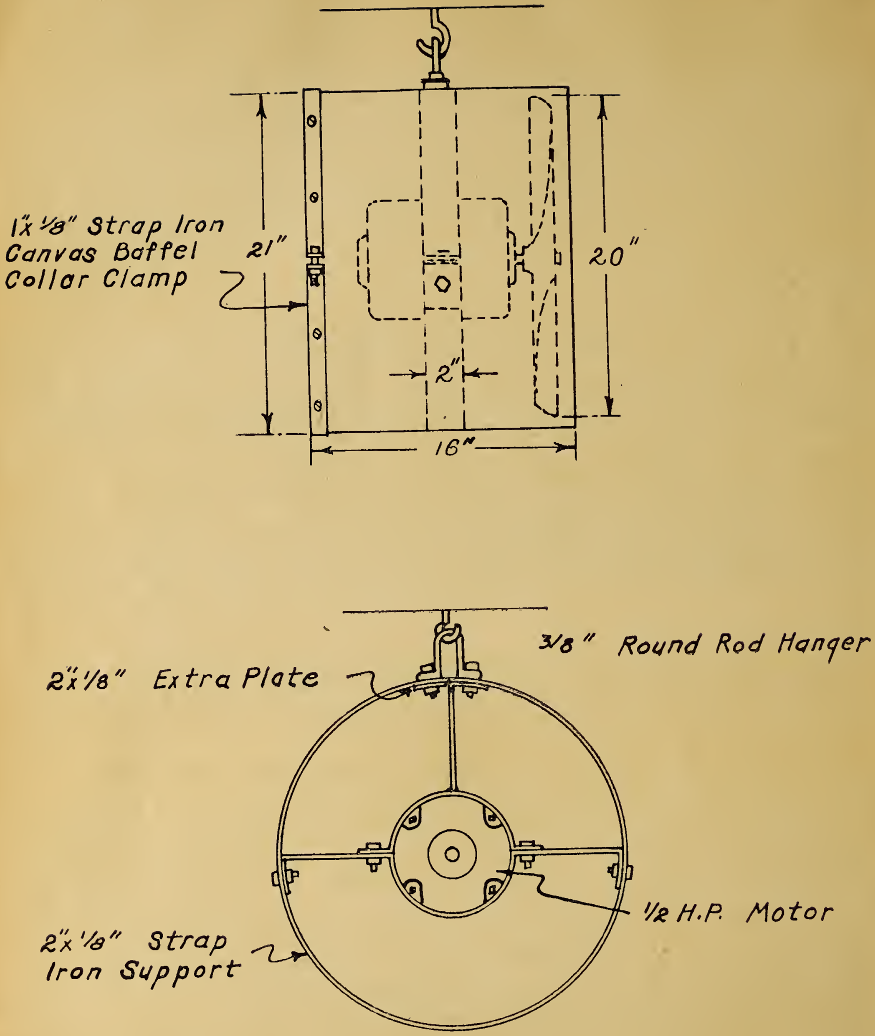
[1] This blade was obtained from the Reading Electric Company, 200 William Street, New York City.



Supports for holding Motor

Figure 3. Cross section and end view of portable bunker fans showing motor supports.

respiration removed from the product itself must be taken into consideration. The infiltration loss during the precooling of a car of potatoes for three hours may be calculated. This is rated as 160 B.T.U. per hour per degree difference in temeprature of the outside air and the inside air. Therefore, 160 x 3 x(82.1—66.1)=7680 B.T.U., which is the infiltration loss.

The sensible heat loss is obtained by multiplying the total weight of potatoes times the specific heat (.91), times the change in temperature by precooling. An average car contains 250 one hundred-pound sacks of potatoes. Therefore, 250 x 100 x .91 (74.5 degrees—57.3 degrees)= 391,000 B.T.U.

The total heat expended in B.T.U. per car during precooling is as follows:

Infiltration leakage	7,680 B.T.U.
Heat removed from air in car	466
Motor heat (two ½-h.p)	10,200
Sensible heat abstracted	391,000
Heat of respiration	3,990
	413,336 B.T.U.

To calculate the amount of refrigeration (or of ice) necessary to cool 25,000 pounds of potatoes from 74.5° F. to 57.3° F., the total number of B.T.U. expended during the process is divided by the number of B.T.U. absorbed per pound or per ton of ice. Since, in melting, each pound of ice absorbs 144 B.T.U., the ice required would be: $\frac{413,336}{144}$ or 2970 pounds, or the equivalent in tons of refrigeration.

From these figures, it is evident that the shippers would be safe in using 1.5 tons of refrigeration, or 3,000 pounds of ice, in the proces of cooling and drying Irish potatoes by the bunker-fan method.

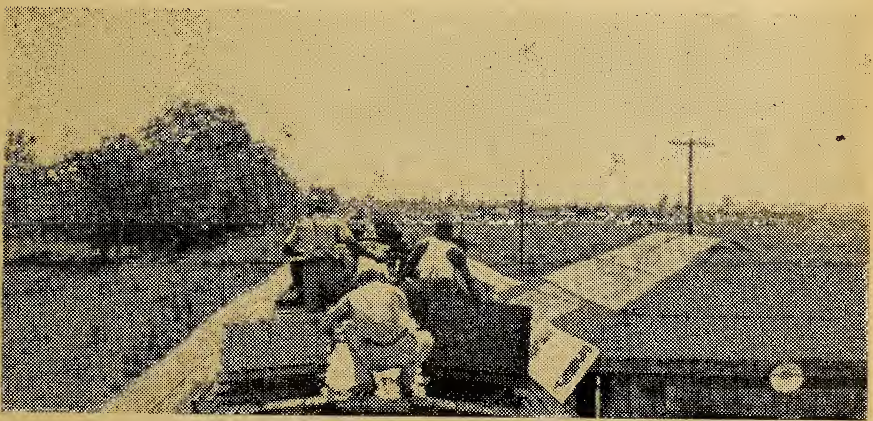


Fig. 4.—Putting ice in the car bunkers before precooling with bunker-fan blowers.

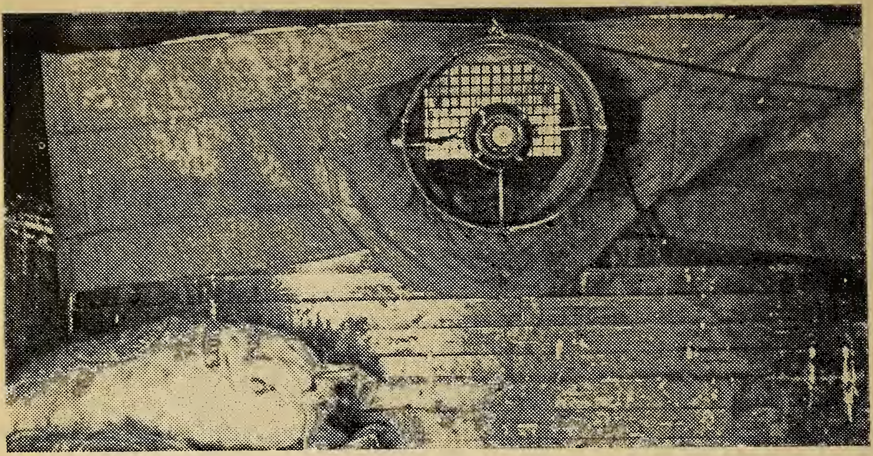


Fig. 5.—Bunker fan in place in the car.

INVESTIGATIONS OF PRECOOLING AND DRYING

Investigation in 1939

Temperature records were made on four cars precooled by the bunker-fan method and on five cars precooled, or "conditioned," by the mechanical refrigeration unit during the 1939 shipping season.

Potato and air temperatures at seven locations in each car were obtained with a thermocouple set having a rotary selector switch connected to a Leeds & Northrup potentiometer as previously described in this report. The sensitive points were inserted into the potatoes or hung in the air currents at desired locations. All containers used for shipping consisted of 100-pound-capacity burlap sacks, and a carload varied from 250 to 260 sacks.

In Table 1 are shown in detail the data taken during these tests. It can be noted from this table that the temperature of the circulating air was somewhat lower when the mechanical units were used to precool, but the average of the total temperature reduction of the potatoes was very nearly the same, varying only 0.4 of one degree. The average temperature reduction for the mechanical precooling units was 15.6 degrees F., while that of the bunker fan units was 15.2 degrees F.; however, the time for precooling with the bunker fans was approximately one hour longer than with the mechanical units. If the mechanical units had operated for the same length of time, a greater reduction in temperature could have been expected.

A temperature below 55° F. is not desirable, as the potatoes are shipped under standard ventilation, and contact with the warmer air while in transit would cause a condensation or sweating on the

TABLE 1. Temperature changes and moisture removal in carlots of potatoes precooled by forced circulation of air, by means of portable fans, through the bunkers when loaded with 2000 pounds of ice in each bunker; and by special mechanically refrigerated precooling units located outside the car. May, 1939.

Car No.	Method of precooling	Temperature at start of precooling (degrees F.)			Temperature at end of precooling (degrees F.)			Ave. temp. delivery of air (deg. F.)	Time of precooling (hrs.)	Ave. total temp. red. (deg. F.)	Average moisture loss per 100 lbs. of product
		bunker	quarter	center	bunker	quarter	center				
I. C. 54299	bunker fans	75	79	76.5	60	60.7	59	55	2 hr., 15 min.	17.1	1.687
N. R. C. 6867	bunker fans	63	66	66	53.5	53.3	52.5	51.7	3 hr., 25 min.	11.9	
I. C. 54821	bunker fans	74.5	73.8	75	57.5	58.3	68.5	54	3 hr.	12.9	
N. R. C. 5910	bunker fans	74	73.5	74	54	53.5	57	53	3 hr., 50 min.	19.0	0.850
A. R. T. 20084	mechanical unit	71	71	73	57.7	67.3	58.5	48	2 hr.	10.6	1.450
A. R. T. 21709	mechanical unit	82	81	80	71.5	56.3	47.5	44.5	2 hr., 15 min.	21.8	1.060
A. R. T. 20184	mechanical unit	71	78.5	75	60.5	68	55	47	1 hr., 15 min.	13.8	*
A. R. T. 17929	mechanical unit	74	74	74	49.5	69	50.5	43	2 hr., 15 min.	17.4	1.030
A. R. T. 16426	mechanical unit	72	71.5	76.7	55.3	65	56	45.5	2 hr., 20 min.	14.5	

* This carlot was precooled 1 hr. and 15 min. the previous evening and held over.

potatoes, which, in turn, would aid in the development of decay-forming bacteria. This point was first brought out by Wright (9) when recording thermometers were placed in cars of potatoes before precooling, and allowed to remain in the cars until arrival at their destination. In all cars the average temperature was approximately 60° F. When the potatoes were precooled below 60° F., there was a gradual rise in temperature during transit until 60° was reached.

It would seem that a longer period of precooling with a circulating air of approximately 55° F. would be the better method as there would be no chance for condensation or sweating on the potatoes during transit.

The bunkers of the cars precooled by the bunker-fan method contained only 2000 pounds of chopped ice. Had the bunkers been full, the increased refrigerating surface would have increased the rate of cooling and given a greater temperature reduction of the potatoes.

Figures 6 and 7 give the comparative rate of cooling potatoes in the cars, showing the average temperatures at the bunker, at the quarter way of the car, and in the doorway. Tests show that cars precooled by the bunker-fan method give a more uniform temperature reduction throughout the car.

A check made on one car using bunker fans showed an average moisture loss of 1.687 pounds per sack. Each sack was weighed

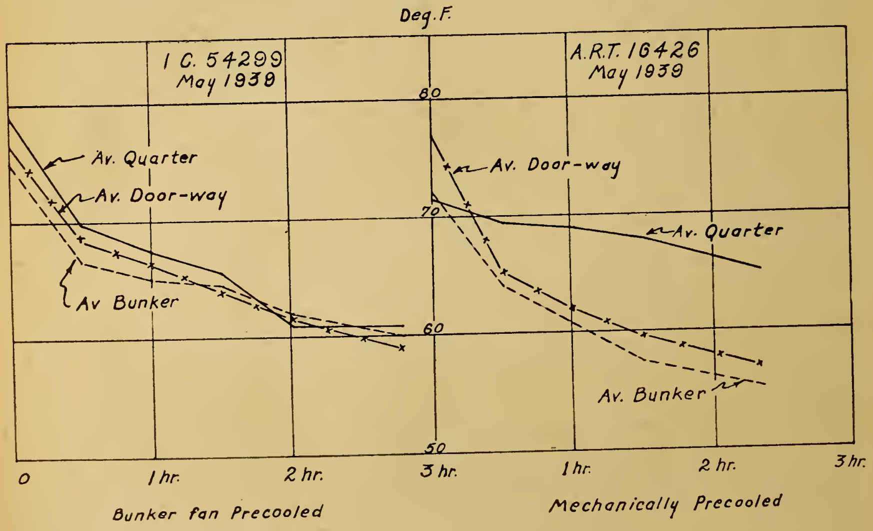


Figure 6. The comparative rate of cooling potatoes in the car by two methods showing average temperatures of the potatoes at the bunker, at the quarter-way, and in the door-way

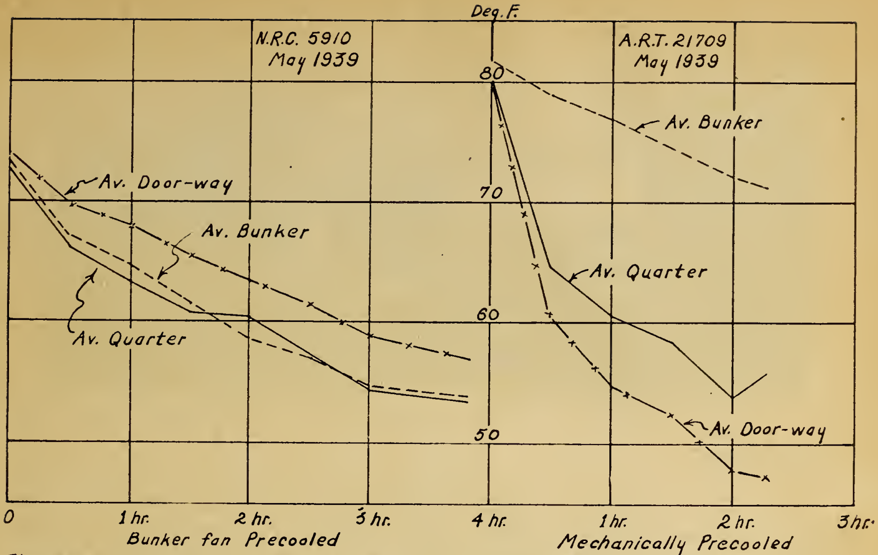


Figure 7. The comparative rate of cooling potatoes in the car showing average temperatures of the, potatoes at the bunker, at the quarter-way of the car, and in the door-way.

before and after precooling. A check sack which was placed on the loading platform for 4½ hours showed a moisture loss of 1.56 pounds. A number of sacks weighed in each of four cars precooled by the mechanical unit had an average moisture loss varying from 1.03 pounds to 1.45 pounds per sack, as shown in Table 1.

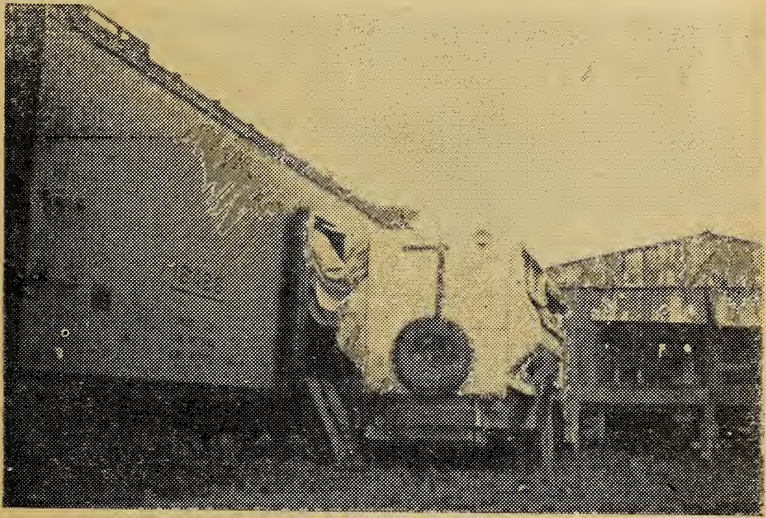


Fig. 8.—Mechanical refrigeration truck preparing to precool a carload of potatoes.

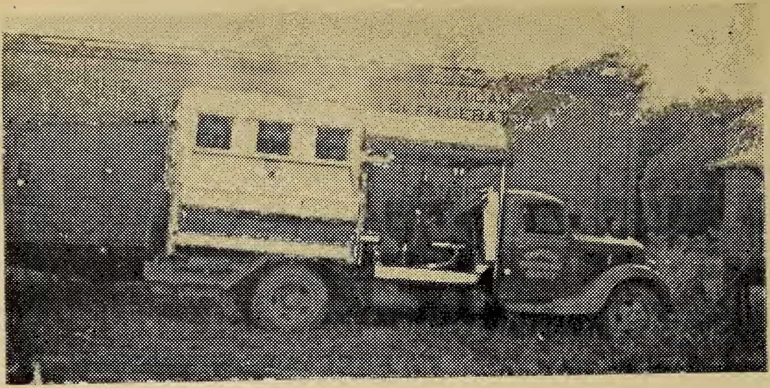


Fig. 9.—Precooling a carload of potatoes by a mechanical refrigeration unit.

Whenever possible, a copy of the arrival inspection report was obtained on all cars checked. Most reports on properly precooled cars showed no decay to less than ½ of 1 per cent decay. There was one exception, however, on one car that was loaded one day and held over until the next day to be finished loading. This car showed 77 spotted sacks amounting to 1,890 pounds of bad potatoes upon arrival at destination.

The cost of precooling in these experiments was $25 per car when using the mechanical refrigerating unit. The precooling cost will vary when using the bunker fans and ice. This variation is due to the size of fan units and to the varying cost of electricity and ice in each locality. Precooling with the bunker fan units used in this experiment cost approximately $8.00 per car.

Investigation in 1940

During the 1940 season, temperature and moisture tests were made on 5 cars cooled and dried by a set of small, light, low-cost bunker fans previously described in this report and shown in Figure 2. No data were obtained on the mechanical refrigeration units during this season as the company refused to cooperate for a similar test.

Figure 10 shows the average temperature reduction in two cars of potatoes at the bunker, the quarter way, and the doorway, when using the experimental bunker fans. It can be noted that, when using this process to precool, the lowest temperatures are always found in the sacks next to the bunkers, and the highest temperatures are found in the doorway. This may be attributed to the short-circuiting of the air from the fans through the open aisle down the middle of the car. The sacks in the doorway receive less

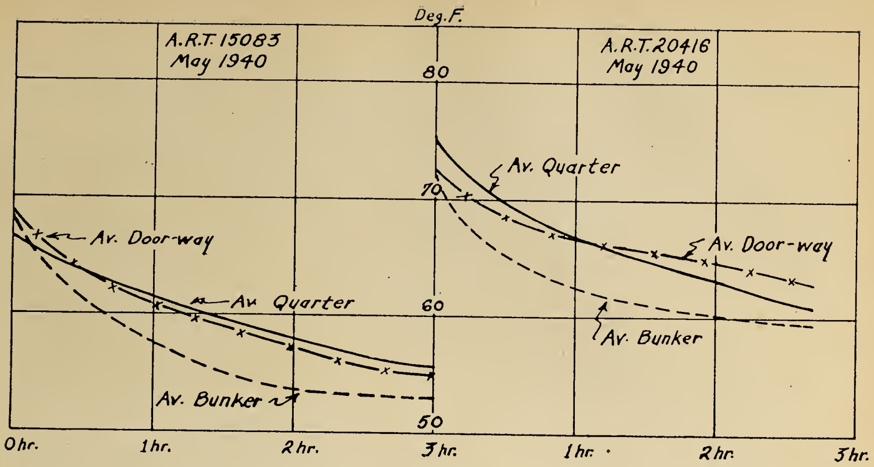


Figure 10. The comparative rate of cooling potatoes in two cars by the portable bunker fan units.

air circulation than those next to the bunker. This factor may be somewhat overcome by placing two or three sacks in the aisle out from the bunker, thus forcing the air to the center of the car before its return to the ice.

Tests were made on two cars to determine the drying effect produced by operating the bunker fans without the use of ice while the cars were being loaded (Table 2). Sacks weighed before the fans were turned on, and after loading was completed, showed that the loss of moisture depended upon the location of the sack in the car. The top and vertical rows next to the aisle lost more moisture than the inside and bottom sacks. It was also found that, with the fans operating for 2 hours and 50 minutes during loading, the sacks next to the bunker near the fan lost as much as 1.4 pounds and those near the doorway lost only 0.31 pounds. The average loss of weight for potatoes that had been blown before icing and then precooled was found to be 1.328 pounds, while those sacks only precooled had an average loss of 1.045 pounds per sack.

One hundred pounds of potatoes were placed in two slatted crates and arranged on top of the eleventh row from the bunker beside a check sack of potatoes. After operating the fans for 2 hours and 50 minutes, these potatoes were weighed. The crated potatoes had lost 1.187 pounds of moisture, and those in the sack .312 pounds. These were placed again in the same positions and the car precooled. After a second weighing, the sacked potatoes had lost a total of 1.249 pounds while the crated potatoes had lost 2.187 pounds.

The crate is obviously the more desirable container for shipping, from a precooling standpoint, but the cost of crates is so

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TABLE 2. Moisture losses from operation of portable fans while loading, and from precooling. May, 1940.

Moisture loss from blowing before pre-cooling (lbs.)	Moisture loss from precooling (lbs.)	Total loss in weight (lbs.)	Location of sacks in car
0.0	0.375	0.375	11th row from bunker, center vertical sack
0.312	0.937	1.249	11th row from bunker, bottom horizontal sack
0.0	0.75	0.75	8th row from bunker, aisle vertical sack
1.312	0.0	1.312	5th row from bunker, top horizontal sack
1.375	0.125	1.50	1st row from bunker, top horizontal sack
1.437	0.812	2.249	1st row from bunker, aisle vertical sack
0.125	0.875	1.00	7th row from bunker, bottom horizontal sack
1.187*	1.00	2.187	Crate placed on top of 11th row from bunker
**	1.25	1.25	2nd row from bunker, top horizontal sack
**	1.187	1.187	7th row from bunker, top horizontal sack
**	0.875	0.875	6th row from bunker, wall vertical sack
**	0.937	0.937	6th row from bunker, center vertical sack
**	1.0	1.0	Doorway, top sack

* Potatoes put in a crate and placed on top of load.
** These sacks weighed and placed in car just before precooling began.

TABLE 3. Temperature changes and moisture removal in carload lots of potatoes precooled by forced circulation of air by means of portable fans. May, 1940.

Car No.	Method of precooling	Temperature at start of precooling (degrees F.)			Temperature at end of precooling (degrees F.)			Ave. temp. delivery of air (deg. F.)	Time of precooling (hrs.)	Ave. total temp. red. (deg. F.)	Average moisture loss per 100 lbs. of product
		bunker	quarter	center	bunker	quarter	center				
A. R. T. 20416	bunker fans	73	75	72	57.5	60	64	56	2 hr., 30 min.	15	0.875
A. R. T. 15083	bunker fans	68.5	67	68	53.5	55.5	56	53	3 hr.	18.6	0.810
A. R. T. 18600	bunker fans	73	76	78	57	65.5	65.5	56	2 hr., 40 min.	14.7	1.070
A. R. T. 22084	bunker fans	66	66.5	68	55	56.5	59.5	54.5	1 hr., 50 min.	9.8	*
A. R. T. 21508	bunker fans	68.5	69.5	71.5	52	59	60	51	5 hr.	12.8	1.207

* Precooling stopped short on this car due to train leaving.

much greater than the cost of sacks that shippers have not felt that the use of crates was justified.

Potato buyers have made some attempt to introduce a 25- and 50-pound-capacity cotton sack for shipping. Unless these sacks are of a coarse weave, the drying of the potatoes after washing will be a longer and harder process.

Table 3 shows the temperature changes and moisture losses of potatoes precooled by forced air circulation by means of portable fans in May, 1940. Owing to the scattered destinations of these cars, an inspection certificate on arrival conditions was obtained only on car A.R.T. 20416, which showed no decay. No complaint was voiced by any purchaser of the remaining cars.

SUMMARY AND CONCLUSIONS

A study made of field conditions showed that the method of digging and handling potatoes in the field was responsible for some decay in transit.

The potato digger cut and bruised fewer potatoes than did the middle-breaker.

The crate proved a better container than sacks for hauling potatoes from the field without bruising.

Investigation showed that some shippers were using very inefficient methods for precooling and drying.

An efficient bunker-fan unit for precooling and drying potatoes can be made at a relatively low cost.

The mechanical refrigeration unit had a lower air delivery than the bunker-fan units, but the latter showed a more even temperature distribution throughout the car.

A more thorough job of drying resulted when bunker-fan units were operated while the car was being loaded before adding ice to the bunkers.

When using fans to precool, with the present method of car loading, lower temperatures in the doorway can be obtained by placing two sacks of potatoes in the aisle leading from the bunker.

Greater moisture loss was obtained from crates than from sacks during precooling by the bunker-fan method.

It is not advisable to have a potato temperature below 55° F. when shipping under standard ventilation.

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PART-TIME FARMING IN A RURAL-INDUSTRIAL AREA OF LOUISIANA

By

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PART-TIME FARMING IN A RURAL-INDUSTRIAL AREA OF LOUISIANA

C. A. Boonstra and Hilliard Jackson*

Introduction

In recent years, part-time farming has become recognized as a type of agricultural activity which influences the nature of farm problems in various localities. Studies of part-time farming are useful, first, because a knowledge of the organization and activities on part-time farms aids in describing and understanding farm enterprises, and second, in order to furnish information to groups and individuals interested in the possibilities of combining industrial and agricultural employment.

The present study of part-time farming is limited to the farm activities of workers employed at a large paper mill in Bogalusa, Louisiana. This locality was selected for study because it is typical of the part-time farming opportunities created by a large industrial plant situated in an area of the South poorly adapted to farming. The expansion of industry in the South, since cities are small, generally leaves rural areas readily accessible, so that a home in the country is within the reach of many workers.

Whether or not part-time farming, associated with full-time industrial employment, should be encouraged for industrial workers in rural areas, is the principal concern of this study. A description of farm organization, estimated earnings, and attitudes is essential to a thorough understanding of this problem, which is particularly vital to groups urging industrial decentralization in the United States.

Extent of Part-Time Farming

Since all types of farmers are likely to work off their farms at times during the year, a uniform definition of part-time farming has never been satisfactorily established. This study is concerned only with part-time farmers who obtain their principal income from industrial employment, and whose farm enterprise is a secondary matter in obtaining a livelihood. There are few statistics relating to this specific type of part-time farming in the United States and in Louisiana.

According to the 1935 Census of Agriculture, 30.5 per cent of all farm operators in the United States worked off their farm one day or more in 1934. However, only 11.2 per cent worked off their farms 100 days or more. In Louisiana, although 21.5 per cent of all farmers worked some time off their farms in 1934, only 6.8 per cent worked 100 days or more. About 23 per cent of the off-farm work of the latter group was classed as agricultural employment.

Part-time farmers are probably most numerous in southeastern Louisiana, although considerable numbers are also concentrated in other areas. The location of industrial enterprises is a principal factor influencing the distribution of part-time farms throughout the state. This is particularly true of industries closely associated with agriculture, such as lumbering, food processing, paper and pulp manufacturing, and fishing and trapping. In areas of Louisiana where these industries are important, more than 10 per cent of all farmers worked 100 or more days off the farm in 1934.

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In Washington Parish, which includes the area studied, 20.4 per cent of all farm operators worked off their farms in 1934, and more than half of these operators worked 100 or more days. Almost all of this latter group were employed in non-agricultural occupations. The part-time farms of the parish are concentrated in Wards 4 and 6 about Bogalusa, the industrial center of this rural area.

Industrial Employment in Washington Parish

This study is restricted to paper mill workers, and all of the 64 part-time farmers interviewed were steadily employed in industry. Their part-time farms were usually established on the poorer phases of the terrace soils along the Pearl River, which forms the Louisiana-Mississippi boundary. Because of poor drainage this land is not well adapted to farming, and is utilized for part-time farming principally because of its availability near the paper mill. The small full-time commercial farms of the area raise cotton or cotton and beef, with a considerable number of subsistence farms.

The paper mill, about which the enterprises of Bogalusa (14,596 population in 1940) are centered, was established in 1918. It has increased its output 70 per cent since 1931 and is the principal source of industrial employment in the parish. The cessation of operations a few years ago by a sawmill which was at one time the largest in the world, removed a second principal source of employment for the residents of the area. The present importance of the paper mill, which is still expanding, is indicated by its 1940 capacity of 675 cords of wood per day, with 950 workers employed directly in the paper mill. In addition, 483 workers were employed in an adjacent corrugated paper box factory, and additional workers were employed in woods operations.

Most of the part-time farms have been established since 1932, when the paper mill instituted continuous operation with three 8-hour shifts each day, later changing to the present system of four 6-hour shifts. The mill employees rotate through the four different shifts, changing each week. No matter which shift the worker is on, he can readily secure at least six hours of daylight in which to work on his farm.

According to the mill executives, the average wage paid to all workers in 1939 was $1,485. White workers averaged $1,622 as compared to $1,026 for colored employees. These average wages are very high relative to returns from full-time farming in Washington Parish, and enable the mill workers to enjoy a favorable standard of living.

The 64 part-time farm operators received an average wage of $1,741, substantially higher than the general average. This is the result of the high proportion of white workers in the part-time farm group, and of the influence of the high earnings of certain skilled workers and minor executives who maintained part-time farm homes. It is interesting to note from this that part-time farming in the area was not an activity by which low-income mill workers supplemented their earnings, but rather a means by which the better-paid workers sought a more satisfactory way of life. With few exceptions, the low-paid unskilled employees of the mill lived in town, and had little interest in or opportunity to engage in part-time farming.

The chief effect of part-time farming on industrial earnings was the increase in transportation costs. According to the workers' estimates, the average cost of transportation was $1.80 a week, including only cash costs for operating an automobile or cash payments to neighbors. This average cost of $93.60 a year indicates a real barrier to part-time farming for low-wage workers. Costs of daily transportation become so great as to set a general limit to part-time farming within 10 to 15 miles of the place of employment.

Social Characteristics of Part-Time Farmers

The families of the industrial workers engaged in part-time farming revealed certain interesting group characteristics. There was a distinct scarcity of individuals in the age group 20 to 29, while the age groups 5 to 14 and 30 to 44 had the largest proportions of the family members of both sexes. Young persons just reaching maturity leave part-time farms to engage in non-farm employment, while the older industrial workers return to the rural areas to rear children.

The heads of the families ranged from 26 to 60 years in age, with the greatest number falling between 30 and 39 years. The families averaged 4.7 members living on the farm, which is somewhat higher than the usual family of four. The part-time farmers were principally local people, as 50 per cent of the 64 workers surveyed were born in Washington Parish. Of the 36 per cent born outside of Louisiana, almost all came from the nearby state of Mississippi. It was noted that relatively few of the mill workers came from outside the area, with the exception of executives and highly skilled employees.

The fact that 61 per cent of the part-time farmers had worked at the mill for a substantially longer time than they had lived on their farms indicated that most of the group had moved to the country from the city. Part-time farming in the area was largely a result of industrial workers, usually brought up on the farm, moving back to the rural area after spending several years in town. Very few part-time farmers appeared to be former full-time farmers who had reduced the scale of their farm operations after obtaining industrial employment.

Only 2 of the 64 part-time farm families were colored. Part-time farm operation requires both ambition and managerial ability, along with a wage sufficient to acquire a farm and to bear the cash cost of transportation to and from the farm. Negroes apparently have neither the opportunity nor the desire to do farm work in addition to their industrial employment.

The part-time farms tended to group along good roads leading into Bogalusa, particularly around local trade centers of the area. The average distance from the mill was 6 miles, with 64 per cent of the farms within a 5-mile radius. Only four workers were more than 15 miles from the mill.

Homes of the part-time farmers were far superior to the usual farm homes of the area. More than three-fourths of the houses were wired for electricity, and most of the families also had refrigerators and other conveniences. It was clearly evident that the majority of the part-time farmers attempted to secure the conveniences of a city home, such as ordinarily would be too expensive relative to the low farm incomes of the area.

Organization of Part-Time Farms

Since the 64 part-time farms varied widely in respect to crop acres, receipts and expenses, earnings, and capital invested, they were classified into three groups —28 residential, 20 semi-commercial, and 16 commercial part-time farms. The principal criteria used in forming this classification were acres in crop land, productive man work units, and cash receipts per farm. These various measures overlapped somewhat, and experienced judgment was necessary in making a final classification. However, Table 1 indicates that the classification follows closely the statistical distribution of each of the factors.

TABLE 1. AVERAGE CROP ACRES, PRODUCTIVE MAN WORK UNITS, AND CASH RECEIPTS, BY TYPE OF PART-TIME FARM, 64 PART-TIME FARMS, BOGALUSA AREA, 1939

TYPE OF PART-TIME FARM	Number in group	Average acres in crops	Average productive man work units[1]	Average cash receipts
Residential	28	2.4	41	$ 10
Semi-commercial	20	10.4	92	81
Commercial	16	25.0	252	639
All part-time farms	64	10.5	116	190

[1] The productive man work units represent the number of 10-hour days per year required to do all the farm work.

Residential part-time farmers operate small farms in order to reduce living costs and secure a better home, not to earn cash income from farming. Semi-commercial farmers have incidental cash sales and a larger scale of operation, but the farmer's principal interest is still production for home consumption. On commercial part-time farms, cash sales ranging from $150 to more than $1,000 indicate that additional income was a principal objective for farm operation.

In determining the usual farm organization for each of these types of farms, the average of modal groups was used, whereas in determining dollar values for receipts and expenses, an arithmetic average of all farms was used. Modal groups were used for farm organization because the small size of crop acres and livestock items makes the figures extremely liable to distortion by unusual enterprises on a few farms. On the other hand, cash items concerning receipts and costs were more uniform, and the arithmetic average for these items was satisfactory.

The 28 residential part-time farms had very small crop and livestock enterprises. The usual farm had 2.4 acres of crop land, which included 1.5 acres of corn, 0.2 acre of peas, 0.2 acre of sweet potatoes, and 0.5 acre in garden. Livestock included 1 cow, 1 other dairy animal, 4 hogs, 24 hens, and occasionally a work animal.

This type of farm organization required an average of only 41 productive man work units, and permitted practically no cash income from sales of farm

TABLE 2. USUAL FARM ORGANIZATION, BY TYPE OF FARM, 64 PART-TIME FARMS, BOGALUSA AREA, 1939

Item	Residential	Semi-Commercial	Commercial
Total crop land (acres)	2.4	10.4	25.0
Total farm land (acres)	10.0	30.0	50.0
Crops:			
Cotton (acres)	0.0	0.0	6.0
Corn (acres)	1.5	8.3	13.9
Peas and other legumes (acres)	0.2	1.0	2.6
Sugar cane for syrup (acres)	0.0	0.0	0.5
Sweet potatoes (acres)	0.2	0.4	0.8
Irish potatoes (acres)	0.0	0.2	0.4
Garden (acres)	0.5	0.5	0.8
Livestock:			
Work stock (number)	1	1	2
Milk cows (number)	1	2	3
Other dairy cows (number)	1	5	3
Sows (number)	0	1	1
Other hogs (number)	4	6	6
Chickens (number)	24	30	30

products. A productive man work unit is the average amount of farm work a man can accomplish in a 10-hour day. In other words, on the usual residential farm one man could care for the farm by spending an average of about two hours a day for the 200 days in the year in which most farm work in the area is done.

The usual semi-commercial farm had 10.4 acres of crops, distributed among 8.3 acres of corn, 1.0 acre of peas, 0.4 acre of sweet potatoes, 0.2 acre of Irish potatoes, and 0.5 acre of garden. The livestock organization included one work animal, 2 milk cows, 5 other dairy animals, 1 sow, 6 other hogs, and 30 chickens. Productive man work units required for this organization are 91, or about 4 to 5 hours a day for 200 days in the year. Although this organization provides principally food for the family, the surplus of feed and livestock permits occasional cash sales.

The usual organization on the 16 commercial part-time farms approached the closest to customary full-time farm organization for the area. Twenty-five acres were in crops, with 6 acres of cotton, 13.9 acres of corn, 2.6 acres of peas, 0.5 acre of sugar cane for syrup, 0.8 acre of sweet potatoes, 0.4 acre of Irish potatoes, and 0.8 acre in garden. Livestock included 2 work animals, 3 milk cows, 3 other dairy animals, 1 sow, 6 hogs, and 30 chickens. Two of the farms in the commercial group operating dairy enterprises were excluded in determining this usual organization. The requirement of 252 productive man work units for the commercial part-time farm indicates that a considerable amount of family or hired labor must be used, as an industrial worker can scarcely care for the peak load in this farm organization. In fact, on a basis of 200 days of labor on the farm, the operator would have to work full time if he did all the labor himself.

Important differences are thus evident between part-time farms in regard to organization. Cotton, because of its high labor requirement, is important principally on the commercial farms. Corn is grown on all farms, being generally used for feeding the milk cow on residential farms, and for feeding all livestock on other part-time farms. Only half of the residential farms had work animals, whereas the commercial farms generally had two work animals. Milk cows were the most characteristic enterprise for part-time farms, since all farms had them. Semi-commercial farms had the most livestock, principally because the farms were larger and more livestock appeared to require less work than larger crop acreages. On all types of farms, only enough hogs and chickens were kept to supply the family needs. The livestock enterprises on several of the part-time farms were influenced by the hog or calf projects of children studying agriculture in high school.

Garden Organization

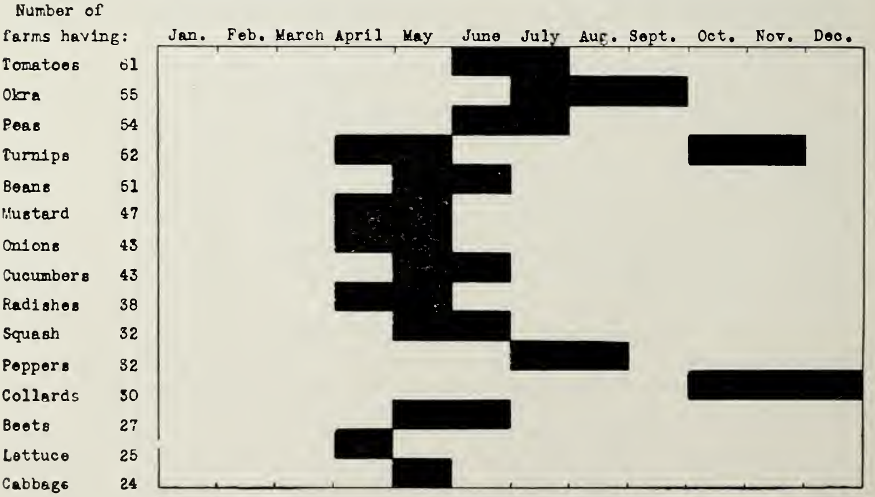
All part-time farmers considered the garden a highly important phase of the farm organization, and family use of the produce was a principal factor in the total value of farm earnings. The average of all farmers' estimates concerning the value of their garden to them was $75, with the semi-commercial farmers placing the highest estimates of any group, $90.

Only one part-time farmer interviewed did not have a garden in 1940, although in previous years he had one. The size of garden varied from 0.1 acre to 1.5 acres, with 0.5 being the most common acreage.

Washington Parish has an average frost-free growing season of about 8 months. Thus, there are about six months in which the less hardy vegetables may be consumed fresh from the garden. In addition, hardy vegetables such as turnips and collards may be grown for use during the colder months.

For all farms, the usual garden organization included the 15 different vegetables listed in Figure 1 according to their frequency. As is evident in the chart, most of the vegetables were consumed in April, May, and June. After July, only

Figure 1. Usual Organization of Garden, 64 Part-Time Farms, Bogalusa Area, 1940*



*The black bars indicate the time of year the vegetables were consumed fresh from the garden.

one or two fresh vegetables were obtained from the garden. Many of the farmers grew turnips and collards during the late fall months, so that January, February, and March were the only months of the year when fresh vegetables were not obtained.

The vegetables most commonly grown by the part-time farmers were tomatoes, okra, peas, turnips, and beans. In addition to fresh vegetables, the gardens furnished sufficient produce for an average of 119 quarts of canned vegetables. Small amounts of fruit from the farm were also canned. The residential part-time farmers canned the least fruits and vegetables. The semi-commercial farmers were the chief consumers of home-canned food.

Farm Products Used in the Home

Part-time farming is carried on largely to produce food for the family, since only 16 of the 64 farms surveyed were commercial in nature. Table 3 lists the quantity and total value of the products which the 64 part-time farm families used at home. These data should not be interpreted too literally, since they are an average of farmers' estimates concerning matters on which recollections are not very definite. In addition, it is extremely difficult to obtain a dollar estimate of the value of garden products to the family. In valuing the livestock and crop products other than garden, the average price received by farmers in the district, as compiled by the Agricultural Marketing Service, was used.

In addition to their gardens, most of the part-time farmers produced pork, poultry, eggs, milk, and butter for home use. Wood and field crops were additional items of some importance on a few farms. The 64 farms produced for home use an average of 401 pounds of pork, 37 chickens, 111 dozen eggs, 460 gallons of milk, and 77 pounds of butter. The average per farm was greatest in all cases for the commercial farms, although in some cases the values are probably larger because of surplus home production beyond the family needs. The commercial and semi-commercial farms, as would be expected, had the greatest value for wood and field crops used. The semi-commercial part-time farmers made the highest estimates for value of garden, with an average of $90 as compared to $63 for residential and $73 for all part-time farmers.

The total value of the various farm privileges added up to an average of $291, and formed the principal income item for most part-time farms. Residential farms averaged only $218 for value of all farm products as compared to $339 for semi-commercial and $357 for commercial part-time farmers.

Capital Requirements For Part-Time Farming

Particular effort was made in this study to obtain information concerning capital requirements for part-time farms in the area. Table 4 presents the average capital investment on 61 part-time farms studied. Only three of the part-time farmers rented farms, and these were excluded in computing the average capital invested in the various types of farms.

The houses on all part-time farms were considerably better than most farm dwellings, and the average value estimated by the farmers was $1,275. Homes on the commercial farms were generally poorer and of lower value than those on resi-

TABLE 3. AMOUNT OF FARM PRODUCTS USED IN HOME, BY TYPE OF FARM, 64 PART-TIME FARMS, BOGALUSA AREA, 1939

Type of Farm	Pounds pork used	Chickens used per year	Dozens eggs used	Gallons of milk used	Pounds butter used	Cords wood used	Value field crops used	Value of garden	Value of all farm privileges
Commercial	536	48	149	565	94	5	$35	$71	$357
Semi-commercial	448	42	110	536	84	7	20	90	339
Residential	291	29	90	345	62	2	8	63	218
All part-time farms	401	37	111	460	77	4	19	73	291
Usual full-time farms*	500	30	100	500	†	8	38	50	262

*Source: Kenneth Bachman and R. J. Saville, "Agricultural Adjustments in Washington Parish" (unpublished manuscript on file at the Louisiana Agricultural Experiment Station).

†Not available.

TABLE 4. VALUE OF REAL ESTATE AND OTHER PROPERTY, BY TYPE OF FARM, 61 PART-TIME FARMS, BOGALUSA AREA, 1940*

TYPE OF PART-TIME FARM	Machinery	Livestock	Land	Dwelling	Other buildings	Average capital
Residential	$ 18	$122	$ 422	$1,267	$ 81	$1,910
Semi-commercial	59	286	767	1,362	195	2,669
Commercial	158	547	1,403	1,174	307	3,589
All part-time farms	68	280	776	1,275	173	2,572

* Three rented farms are excluded from this tabulation.

dential and semi-commercial part-time farms. Investment in land was next in importance, ranging from $422 on residential to $1,403 on commercial part-time farms. Because of residential use, land values were much higher than justified by farm returns in the area.

Livestock was third in importance on all part-time farms, followed by buildings other than dwellings, and last of all by farm machinery and equipment. The average farm capital investment on all types was $2,572, which appears to be a reasonable figure for the investment required on most part-time farms.

The usual farm machinery and equipment on the part-time farms are listed in Table 5. The most common implements were turning plow and Georgia stocks, which are one-horse plows used in preparing land for planting, and in cultivating. Only the larger farms had a harrow, and relatively few had a wagon. All farms had the various essential small tools. A few commercial farms had cotton planters, fertilizer distributors, and middle breakers.

TABLE 5. USUAL MACHINERY AND EQUIPMENT ON PART-TIME FARMS, 64 PART-TIME FARMS, BOGALUSA AREA, 1940

TOOLS AND EQUIPMEPT	Number of part-time farms having equipment	Percentage distribution
Small tools	64	100.0
Turning plow	62	96.9
Work gear	51	79.8
Georgia stocks	50	78.1
Spring-tooth harrow	40	62.5
Wagon	23	35.9

The residential part-time farmers had an average investment in machinery of only $18. Many individuals borrowed implements from neighbors or purchased tools jointly with other farmers.

The average value of livestock for the 61 farms was $280, ranging from $122 on residential to $547 on commercial part-time farms. However, the commercial group here includes two dairy farms, on which the investment in livestock averaged $2,000. In general, livestock investments averaged only slightly more than $200 for the average part-time farm.

Farm Indebtedness

Only 28 of the 61 part-time farms operated by owners were mortgaged. The average indebtedness was $522 on these 28 farms, with little difference between types. The original mortgages averaged $812, indicating that substantial payments were being made by the part-time farmers. The common reasons given for mortgaging the farm were to build a good dwelling, make repairs to the house or to purchase land for farm operations. The proportion of part-time farms free of debt was substantially higher than the proportion for all full-time farms of the area, according to Census figures.

Since 5 per cent interest on capital was deducted in computing the earnings on all farms, the mortgage interest was not considered a cost of farm operation in this study. Part-time farmers could afford to borrow all the capital needed at 5 per cent and still receive the average farm earnings indicated in the following discussion.

Farm Earnings and Expenses

Table 6 presents a financial summary of the average income and expenses of the three types of part-time farms. An inspection of the table makes obvious the difficulty of preparing financial summaries for part-time farm operation. The

TABLE 6. FINANCIAL SUMMARY, BY TYPE OF PART-TIME FARM, 62 PART-TIME FARMS, BOGALUSA AREA, 1939[1]

Farm income and expense	Residential	Semi-Commercial	Commercial	All farms
NUMBER OF FARMS	28	20	14	62
CASH FARM RECEIPTS:				
Crops	$—	$ 12	$ 241	$ 58
Livestock and livestock products	7	64	123	51
Other, including govt. payments	3	5	47	14
	10	81	411	123
ESTIMATES OF NON-CASH RECEIPTS:				
Increase in inventory	41	44	57	46
Value of farm products used	218	339	377	293
Credit for house rent	155	184	158	165
TOTAL FARM RECEIPTS	424	648	1,003	627
CASH FARM EXPENSES:				
Feed	48	61	48	52
Labor	4	57	121	48
Fertilizer	10	27	67	28
Other current expenses	6	18	51	20
Purchase of livestock and equipment	31	31	109	49
	99	194	396	197
ESTIMATES OF NON-CASH EXPENSES:				
Depreciation (5% on bldgs. and equipment)	66	83	71	72
Decrease in livestock	2	14	41	15
Unpaid family labor	10	37	79	34
TOTAL FARM EXPENSES	177	328	587	318
CASH RECEIPTS LESS CASH EXPENSES	–89	–113	15	–74
TOTAL RECEIPTS LESS TOTAL EXPENSES	247	320	416	309
INTEREST ON CAPITAL (5%)	89	133	159	119
RETURN FOR OPERATOR'S LABOR	158	187	257	190

[1] Excludes 2 commercial part-time farms with dairy specialty.

majority of the receipts are estimates of non-cash items, as are a large portion of the expenses. The summary was constructed to obtain a final estimate that would indicate the monetary value of the return for the operator's labor, including all types of receipts and expenses. The inclusion of certain items is arbitrary; therefore the reader may wish to omit some items in interpreting the data. For example, the total return to all members of the family for their labor on the farm must include the unpaid family labor, listed as an expense, in addition to the return for the operator's labor.

Cash receipts were negligible on the residential part-time farms, and of real importance only on the commercial farms. Two estimated figures, value of farm products used and the credit for house rent, formed almost the entire receipts for residential and semi-commercial part-time farms. Cash farm expenses on all except commercial farms were considerably in excess of cash receipts. In the average of 62 farms, farm privileges plus house rent credit accounted for 73 per cent of total farm receipts.

Cash farm expenses were greatest for feed, labor, and fertilizer on all types of part-time farms. Feed costs were the heaviest items for both residential and semi-commercial farms, but labor and fertilizer costs were the greatest expenses for commercial farms. New investment in livestock and equipment was considered an expense of the current year, since it was reflected in the receipts through the increase in inventory.

In general, part-time farm cash expenses follow a general pattern. On residential farms with little land in crops, feed is the principal cash expense. As farms grow larger, and more feed is grown, the important items of cash expense swing to hired and cropper labor, and to fertilizer for cotton production.

Taxes were not important as a cash expense, since all owner-operated farms received the benefits of the $2,000 homestead tax exemption provision in Louisiana. Only 8 of the 64 part-time farmers paid a property tax in 1939.

Part-time farmers of the residential and semi-commercial type put more cash into their farms each year than they received back in cash. Commercial part-time farms did little better than break even on a cash basis. Since the highly important non-cash receipts and expenses are tangible only in the long run, the part-time farmers are amply justified in their frequent statement that, on a cash basis, their farm costs them more each year than they get out of it. However, in making this statement the workers ignore the fact that the excess of cash expense over cash receipts really represents a purchase of farm products for the home. The fact that total farm receipts exceeded total farm expenses by an average of $309 shows that the workers really secured a net income from their investment of wages and labor in the farm.

When 5 per cent interest on the average capital invested in the farm property was deducted as a cost, the 62 part-time farm operators received an average of $190 for their labor and management on the farm. Between the various types, this figure ranged from $158 on residential and $187 on semi-commercial, to $257 on commercial part-time farms. In most cases, the final return for the operator's farm labor was less than the value of farm products used in the home, demonstrating that part of the excess of expenses and interest on capital was an expenditure of wages in farm products for home consumption.

TABLE 7. TOTAL LABOR EARNINGS ON PART-TIME FARMS, 62 PART-TIME FARMS, BOGALUSA AREA, 1939[1]

Type	Return for operator's farm labor	Annual industrial wage	Total labor earnings
Residential	$158	$1,516	$1,674
Semi-commercial	187	1,903	2,090
Commercial	257	1,911	2,168
All types	190	1,676	1,866

[1] Excludes two commercial part-time farmers with dairy specialty.

If this average final return for the operator's farm labor is added to the operator's annual industrial wage, his total earnings for the year are substantially increased, as indicated in Table 7. The average total earnings for all types of part-time farm operators in 1939 was $1,866. The farm earnings must be considered principally as a saving of industrial earnings through decreased cash food expenses.

Factors Influencing Farm Earnings

The part-time farmer's earnings from farm operation, or total farm receipts less total farm expenses and interest on capital, is a fairly adequate measure of the part-time farm success in providing a return to the worker for his labor spent on the farm. On the 64-part-time farms surveyed, the farm labor earnings varied from —$209 to $706. Although the factors related to earnings are more difficult to ascertain on part-time farms than on full-time commercial farms, the study brought out several factors which appeared to be associated with high returns from part-time farming.

TABLE 8. SIZE OF FAMILY AS RELATED TO RETURN FOR OPERATOR'S LABOR, 64 PART-TIME FARMS, BOGALUSA AREA, 1939

Size of family	Number of part-time farms	Return for operator's labor
2 - 3	22	$155
4 - 5	23	181
6 - 7	13	272
8 or over	6	293

The most important factor was size of family. Returns for the operator's labor increased steadily with larger families (Table 8). This is an entirely logical relationship, since the principal receipt on part-time farms is farm privileges, and large families grow and use more products for the home. Small families of a man, wife, and one child averaged $155 in earnings, which increased steadily up to an average of $293 for the six families with 8 or more individuals each. Larger families were also generally associated with increasing age of the farm operator, thereby causing an apparent positive relationship between age and farm earnings.

A tabulation of acres in crops and the return for the operator's labor indicated that there was an optimum acreage of 8 to 13 acres in crops for part-time farms. Earnings on these crop acreages averaged $325, more than $100 above the average for any other acreage group (Table 9). Farms of this crop acreage apparently are best suited to provide all the products used in the home, sufficient corn to eliminate heavy feeding costs for the livestock, and yet permit the operator to handle the work without hiring additional labor.

TABLE 9. ACRES IN CROPS AS RELATED TO RETURN FOR OPERATOR'S LABOR, 64 PART-TIME FARMS, BOGALUSA AREA, 1939

Acres in crops	Number of part-time farms	Return for operator's labor
Under 3	19	$175
3.0 - 7.9	15	187
8.0 - 12.9	8	325
13.0 - 17.9	9	141
18.0 and over	13	221

The relatively few part-time farms without cows had substantially lower earnings, as would be expected. Although the return to the operator tended to increase somewhat with the number of cows, there was no significant advantage in having more than two cows. Production of milk and butter beyond family needs did not appear profitable for part-time farms.

In general, the influence of all factors bearing on the value of farm privileges can be summed up in the general statement that the return for the operator's labor increased as the value of farm privileges increased (Table 10). The factor thus most important is a size of family able to utilize considerable farm produce. As a result, farm earnings increased up to an optimum of 8 to 13 crop acres, 2 cows, and 0.8 or more of an acre in garden.

TABLE 10. VALUE OF FARM PRIVILEGES AS RELATED TO THE RETURN FOR OPERATOR'S LABOR, 64 PART-TIME FARMS BOGALUSA AREA, 1939

Farm privileges	Number of part-time farms	Return for operator's labor
$ 76 - 199	18	$ 63
200 - 299	14	212
300 - 399	22	251
400 - 499	7	356
500 and over	3	252

For part-time farms having cash receipts, the data indicated that cash receipts were not significant in influencing farm earnings unless the receipts were more than $100 (Table 11). The 14 farms having no cash receipts averaged higher returns to the operator than 24 farms which had from $1 to $100 of cash receipts. The 24 farms with more than $100 in cash receipts, however, increased their earnings substantially over the former groups. Unless a part-time farmer could really operate on a commercial scale sufficient to use both his labor and that of a cropper, it appeared that he might as well make no attempt to sell farm products. This conclusion from the statistical data is supported by common

TABLE 11. CASH RECEIPTS, AS RELATED TO RETURN FOR OPERATORS LABOR. 64 PART-TIME FARMS, BOGALUSA AREA, 1939

Cash receipts	Number of part-time farms	Return for operator's labor
No receipts	14	$169
$ 1 - 49	18	150
50 - 99	8	166
100 - 199	12	271
200 and over	12	270

opinion among the part-time farmers. If a part-time farmer does operate on a commercial scale, the best means of increasing farm earnings is to work long hours on the farm in order to avoid heavy costs for hired labor.

Two factors sometimes considered important in analyzing the earnings of part-time farms were not supported by consistent relationships in the Bogalusa area. These were the industrial wage of the operator, and the miles the farm was distant from the mill. Very few farmers were farming to supplement low incomes; therefore no relation could be expected. Miles from market also had relatively little significance when the chief operations of the farm were devoted to food for home use.

Attitudes Toward Part-Time Farming

Each of the 64 mill employees was asked to give his chief reason for engaging in part-time farming (Table 12). The most common reason, given by 31 per cent of the farmers, was that their farm activities helped insure future security. The older workers, in particular, gave this reason. The general concept among the majority of part-time farmers was that by investing present earnings in farm property and equipment, they were saving for their old age or against the possibility of losing their industrial employment.

TABLE 12. REASONS FOR LIVING ON PART-TIME FARMS, BY TYPE OF FARM, 64 PART-TIME FARMS, BOGALUSA AREA, 1940

Reasons	Commercial	Semi-commercial	Residential	All farms Number	All farms Per cent
Future security	5	8	7	20	31.2
Reduce living expenses	2	6	6	14	21.9
Accumulate capital	2	1	1	4	6.2
Other economic reasons	2	2	4	8	12.5
To rear children	2	--	1	3	4.7
Likes to farm	1	1	4	6	9.4
Likes the country	1	1	2	4	6.2
Hobby	1	1	1	3	4.7
Something to occupy time			2	2	3.1
Total economic reasons	11	17	18	46	71.9
Total non-economic reasons	5	3	10	18	28.1
Number of part-time farms	16	20	28	64	100.0

The second most prevalent reason was to reduce living expenses. It is significant that additional cash income was not an important reason for part-time farming, except among a few commercial part-time farmers.

Non-economic reasons were also important causes of part-time farming activities. Twenty eight per cent of the part-time farmers were living on farms as a better place to rear children or because they enjoyed the country, principally as a way of life regardless of the costs or returns in an economic sense. Most of the group giving non-economic reasons were workers on residential part-time farms.

Objections to part-time farming were few, and 53 per cent of the 64 farmers offered no criticisms at all. The chief objections of the remaining farmers were the expenses of transportation, and the lack of conveniences. These objections were offered chiefly by the workers more remote from Bogalusa.

The majority of the part-time farmers, 61 per cent, stated that they would prefer full-time farming to industrial work if farm product prices would assure them as satisfactory a living as their present industrial employment. However, as a consequence of the relatively high wages at the paper mill, it is unlikely that any one of the 64 workers will shift to full-time farming so long as he can maintain his present industrial employment.

Summary

According to the analysis in this study, the optimum size part-time farm for an industrial worker in the Bogalusa area was one that most nearly produced the farm products needed for family consumption. Farms larger than this, although having substantial cash sales, were not generally profitable because of high cash expenses, particularly for hired labor and fertilizer. Commercial part-time farmers either were forced to put unduly long hours of work into the farm for a relatively small return, or to hire labor and lose money because of the high cash expense. On the other hand, some residential farms were too small, and could profitably add additional acreage to reduce feed costs, with relatively little additional labor and expense.

In general the conclusion may be drawn that the paper mill worker on a 6-hour shift, living on a 25-acre farm, with 10 acres of crop land on which are grown corn for two cows, one work animal, 5 hogs, and 30 chickens, with a few sweet potatoes, and one-half acre of garden for the family food needs, has the optimum size part-time farm. Capital requirements for such a farm are moderate, and a total investment of $2,500 in land and buildings permits the erection of a house comparing favorably in conveniences and other respects to a city home.

The total productive man work units with such an organization varies from 80 to 100, depending on the extent to which intensive crops like sweet potatoes are grown. If the operator works on the farm approximately 200 days a year, he should be able to do all the work himself by spending 4 to 5 hours a day on farm tasks. However, since the care of livestock requires some work 365 days in each year, the daily labor requirement is probably less than 4 hours a day except during the peak load in the spring.

In return for his labor spent on a part-time farm of this type, a mill worker can expect to receive from $150 to $200 in food products for family consumption, after allowing for all expenses including depreciation, unpaid family labor, and interest on capital. In addition, a large family with children of sufficient age to be useful can increase its earnings still further by expanding intensive food production. However, the actual earnings will depend largely on the desire of the operator. Since industrial wages make him independent of the farm, he may not be disposed to spend much time in securing the relatively low returns per hour of farm labor.

The cost of commuting to and from work is a chief factor limiting the extent of part-time farming about a small industrial center. Part-time farms about Bogalusa clustered together in neighborhood centers within 10 miles of the town. Farmers farther removed had costs for commuting of more than $4 a week, or $200 a year, which is a substantial reduction in a wage of $30 to $40 a week and is greater than the average farm return of $190 to the operator. Although the cost of commuting for all farms is $94, or almost half the average farm earnings, this cost cannot really be considered a true charge against part-time farms near town, since most of the workers would own and operate automobiles even though they lived in the mill town.

It should be stressed that the principal motive of most part-time farmers was the desire to save and acquire a home for future security. The quality of the land and the profitability of farming are not major considerations in locating the farm. In addition, the part-time farmers in the Bogalusa area were the mill workers most enterprising, most thrifty, most interested in future security, and with earnings sufficiently large to permit the purchase of a farm and to pay the costs of transportation.

For industrial workers of this type, working relatively short shifts each day, part-time farming may be recommended as a means for reducing living expenses and establishing a way of life superior to that in a mill village. However, industrial workers who are not disposed to work long hours in addition to the mill shift, who regard a part-time farm as desirable only if it returns a cash income, and whose earnings are insufficient to establish a good rural home, will be disappointed in attempts at part-time farming.

In other words, part-time farming in a rural-industrial area of the South should be considered primarily as a way of life, not as an easy means of supplementing the wages of low-income industrial workers. This conclusion may have considerable importance for government policy in future years, if the advocates of decentralization of industry are successful in influencing the establishment of more wage jobs in the distressed rural areas of the South.

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LOUISIANA BULLETIN NO. 334 NOVEMBER, 1941

The Resident Laborer on the Sugar Cane Farm

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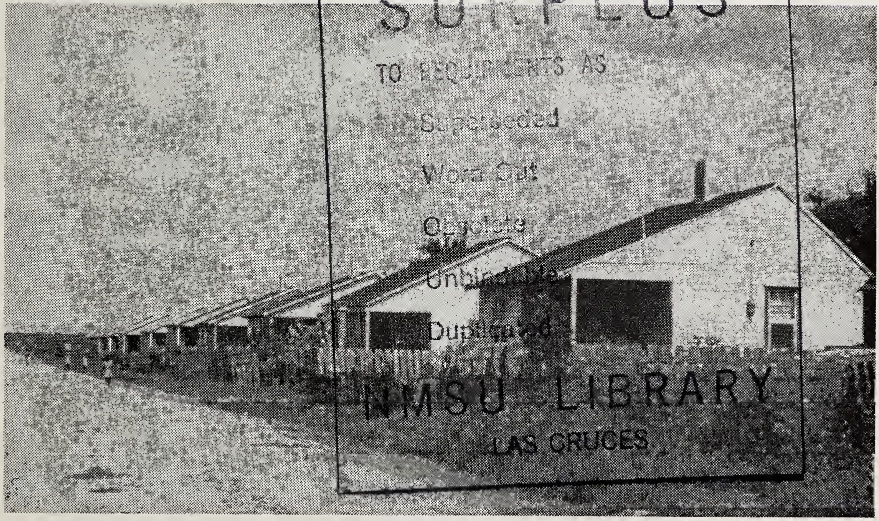
By

HAROLD HOFFSOMMER

In cooperation with the Tenure and Labor Relations Section, Division of Program Planning, Agricultural Adjustment Administration, United States Department of Agriculture



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THE RESIDENT LABORER ON THE SUGAR CANE FARM*

HAROLD HOFFSOMMER

INTRODUCTION

Purpose and General Point of View

This study aims at a social and economic description of the manner of life of the people who work as laborers resident on the sugar cane farms of Louisiana. The results of such a study are of particular interest and value in view of the importance of the resident laborer in the economy of the sugar cane farm and more particularly at the present time because of changes now occurring in the farming setups incident to mechanization and the impact of national control over sugar production.

Scope of the Study

Based largely on data derived from 100 sugar cane farms distributed over nine sample parishes in the sugar cane area of Louisiana, the present study focuses on the analysis of interviews conducted largely between January and June of 1937 with 328 resident laborers, share croppers and tenants. Of these 328 families roughly 75 per cent were resident laborers, 20 per cent tenants and 7 per cent share croppers. Farms with less than 30 acres of cane for the 1936-37 crop year were excluded from the sample on the assumption that typical labor and tenancy conditions would not obtain on farms operating less than this acreage. While the

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* The present publication deals largely with information secured from interviews with resident laborers living on Louisiana sugar cane farms. A previous publication by the author, entitled *The Sugar Cane Farm—A Social Study of Labor and Tenancy,* Louisiana Bulletin Number 320, is concerned with a broad view of the social organization of the cane farm. A forthcoming publication now in preparation will deal specifically with the problem of seasonal sugar cane labor.

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study covered the entire labor setup on each of the 100 farms, including data from the operator and nonresident laborers, the present analysis, as stated above, is confined largely to a consideration of the resident laborer.[1]

THE RESIDENT LABORER FAMILY

Importance in Sugar Cane Farming

The resident laborer who receives wages and perquisites rather than a share of the crop constitutes by far the most prominent type of labor on sugar cane farms. Of a total of 1,086 families (exclusive of operators) living on the 100 farms studied, 83 per cent were resident laborers, 14 per cent tenants and 3 per cent share croppers.[2] The relative percentages of these classes have varied scarcely at all over the period 1933-36 for which data were collected.[3]

Color and Nationality of Head

Among the families, other than the operators and special workers living on the 100 sugar cane farms, colored families outnumbered whites two to one. St. James, with more than 93 per cent, reported a higher percentage of colored than any of the other parishes. In the area as a whole, three-fourths of the resident laborers were colored, as were two-thirds of the share croppers and slightly less than one-fourth of the tenants. Only in the tenant group does the proportion of whites exceed that of the colored (Table 1).

As to cultural descent, the white families were predominantly French. Out of a total of 110 white families, 98 claimed French descent and 7, Spanish. Only two of the families reported English descent. The impact of the French culture, as indicated by language, has been very definite on the people residing in the sugar area whether of French descent or not. Of the 328 families interviewed, 30 per cent of which were of French descent, over 27 per cent spoke French exclusively in the household and an additional 20 per cent spoke French and English. Among the white families, 59 per cent spoke only French and an additional 32 per cent spoke French as well as English with the greater emphasis on French in

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[1] For a complete explanation of the sampling procedure and background statement for the larger study, see the author's bulletin, *The Sugar Cane Farm—A Social Study of Labor and Tenancy,* Louisiana State University Experiment Station Bulletin Number 320, 1940.

[2] It should be noted that in the actual sample of families studied, as indicated in the preceding paragraph, resident laborers and tenants are slightly overrepresented and share croppers slightly underrepresented in proportion to the totals of these tenure groups living in the area.

[3] The percentage of the total families living on the farms who were resident laborers (exclusive of owners and specialized workers) was as follows: 1933—83.8; 1934—83.8; 1935—83.0; 1936—83.1.

TABLE 1. TENURE STATUS AND COLOR OF FAMILIES INCLUDED IN STUDY WHO WERE LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY PARISH, 1936*

PARISH	BOTH COLORS				WHITE				NEGRO			
	Total	Resident Laborer	Share Cropper	Tenant	Total	Resident Laborer	Share Cropper	Tenant	Total	Resident Laborer	Share Cropper	Tenant
TOTAL												
Number	328	242	24	62	110	55	8	47	218	187	16	15
Per cent	100.0	73.8	7.3	18.9	100.0	50.0	7.3	42.7	100.0	85.8	7.3	6.9
Assumption	62	58	....	4	23	19	...	4	39	39	....	....
Iberia	32	20	4	8	11	5	2	4	21	15	2	4
Iberville	48	30	2	16	21	6	...	15	27	24	2	1
Lafayette	28	12	7	9	13	2	4	7	15	10	3	2
Lafourche	25	19	....	6	16	10	...	6	9	9	....	....
Pointe Coupee	69	44	9	16	12	2	...	10	57	42	9	6
St. James	29	26	....	3	2	1	...	1	27	25	....	2
St. Mary	18	16	2	....	5	3	2	....	13	13	....	....
Terrebonne	17	17	....	....	7	7	...	....	10	10	....	....

*Of a total of 1,086 resident laborers, share cropper and tenant families living on 100 sample farms, 328 were interviewed for this study.

most instances.[4] Only 5 per cent spoke English exclusively. Among the Negroes observed, 11 per cent spoke only French and an additional 14 per cent were bilingual French and English. Thus 25 per cent of the Negroes and over 90 per cent of the whites spoke French (Table 2).

TABLE 2. LANGUAGE USED BY 328 TENANT AND LABORER HOUSEHOLDS ON 100 LOUISIANA CANE PLANTATIONS, BY RACE, 1936

LANGUAGE USED	TOTAL		WHITE		NEGRO	
	Number	Per cent	Number	Per cent	Number	Per cent
TOTAL	328	100.0	113	100.0	215	100.0
English	167	50.9	6	5.3	161	74.9
French	90	27.5	67	59.3	23	10.7
French and English	67	20.4	36	31.9	31	14.4
Other	4	1.2	4	3.5	...	.....

Place of Birth of Head

More than 96 per cent of the heads of families were born within the state of Louisiana. Of the twelve born elsewhere, eight were from Mississippi, and one each from Georgia, Arkansas, Kentucky and New Mexico. Obviously, few laborers have recently entered this area from other states. Of the total white families, only one head was born outside the state. Among the Negroes, eleven heads were born in other states. Although the cases are too few for extended generalization, an obvious deduction is that laborers are already relatively plentiful in the area and that little inducement is offered to outsiders for coming in. In fact, the general movement of population has been away from rather than into the area. This movement has been particularly accentuated following critical periods in the economic history of the industry.[5] Currently, one of the most persistent problems of the Sugar Bowl is that of furnishing adequate employment, in the face of crop restriction[6] and increased farming efficiency, to laborers already residing in the area.

The number of laborers born in other states was probably at a minimum at the time the present study was made. Although sugar production had risen rather consistently for the past ten years to a relatively high point at the time of the study, labor needs had not increased proportionately because of the introduction of better varieties of cane and more efficient agricultural methods. A study made in 1900 by J. Bradford Laws of 301 Negroes in West Baton Rouge and St. Mary parishes, shows that at that time 18 per cent of the Negroes were born outside of the state.[7] It should be explained, however, that during grinding season, when employment increases, the number of workers from outside sources also increases, although here again the planters depend largely on local labor.[8] The present discussion deals only with laborers resident on the farms.

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[4] It was obviously necessary to do a considerable amount of the interviewing in French. Where both languages were spoken a great many preferred to speak in French rather than English.

[5] T. Lynn Smith, "Depopulation of Louisiana's Sugar Bowl," *Journal of Farm Economics,* Vol. XX, No. 2, May, 1938.

[6] As this bulletin goes to press announcement has just been made that there will be no crop restriction for the year 1942.

Age of Head

Heads of resident laborer families show an excess of those in the younger age groups as compared with the heads of Louisiana families as a whole, smaller numbers in the middle age groups, and a smaller number in the extremely old group (Table 3).

TABLE 3. AGES OF HEADS OF ALL LOUISIANA FAMILIES COMPARED WITH HEADS OF RESIDENT SUGAR CANE LABORER FAMILIES, BY RACE

AGE GROUPING	LOUISIANA*	RESIDENT LABORERS		
		Total	White	Negro
Under 25 years	8.0	15.3	7.3	17.6
25-34	25.7	25.6	23.6	26.2
35-44	26.6	22.3	32.8	19.3
45-54	21.2	20.7	21.8	20.3
55-64	11.9	10.3	12.7	9.6
65-74	4.9	5.0	1.8	5.9
75 and over	1.6	0.8	....	1.1

*1930 U. S. Census, Population Volume VI, table 56, p. 49.

Negro heads are considerably in excess in the age group under 25 but are underrepresented in the middle age group. Among white resident laborer heads, 18.2 per cent are less than 30 years of age as compared with 34.2 per cent for the Negroes. On the other hand, for the age group 35-44, whites show a percentage of 32.8 as compared with 19.3 for the Negroes. The cause of this situation is not clear. Few Negroes are classed as tenants so it is evident that a rise in tenure status from resident laborer to tenant is not an adequate explanation. Apparently a considerable number of Negroes give up residence on the sugar farms between the ages of 25 and 35 and go into other occupations, whereas the whites are more likely to stay on during this period, possibly because their hope of rising in the tenure scale is somewhat greater.[9] Among the whites, tenants' ages were somewhat higher than those of resident laborers.

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[7] "The Negroes of Cinclare Factory and Calumet Plantation, Louisiana," *Bulletin of the Department of Labor, Number 38,* Washington, D. C., January, 1902, p. 99.

[8] A forthcoming bulletin now in preparation deals specifically with the subject of harvest season laborers.

Size of Household

As might be expected, due to their younger age, resident laborer families were, on the average, smaller than either tenant or cropper families. For the total of 328 families under consideration, the average size household was 4.7 persons, as compared with 6.1 persons for the tenants, 5.7 for the share croppers and 4.3 for the resident laborers. Nearly one-half of the resident laborer households consisted of three or less persons but roughly only 10 per cent of the tenants and croppers had such small households. In fact, among all tenants more than 60 per cent of the households had six or more members, and among the white tenant families, which were the largest, 11 out of 62 reporting had households of nine or more persons (Table 4).

Negro households, with an average of 4.4 persons, were one person smaller per household than white families. This might be partially accounted for on the basis of the younger age grouping among the Negro heads, although the relatively smaller size of Negro families is in keeping with the situation for the state as a whole. White households had proportionately fewer with less than five members but more with seven or more members. Only among the share croppers were the Negro households larger than the white.

The figures quoted above refer to size of household which includes, in 18 per cent of the cases, persons living with the household group who were not members of the immediate family. A slightly greater percentage of these were living in white than in colored families. The average number of persons other than the immediate family was 1.5 in the 60 households reporting this type of arrangement. Combinations of two or more families were rare, only 14 out of 328 households being of this type, with the white showing a slightly greater frequency than the colored.

Education

Nearly one-half of the male family heads of tenants, laborers and croppers living on the sugar cane farms had received no formal education. In addition, nearly another third had completed no more than three grades in school. Combining these two groups, it may be said that three-fourths of these tenant, cropper and resident laborer family heads were essentially illiterate,[10] with an additional 19 per cent which might be classed as just over the literacy line, having completed a fourth, fifth or sixth grade education. Only eight out of the total number of male family heads had received some high school education (Table 5).

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[9] Out of 110 white families, 47 were tenants as compared with 15 Negro tenants out of a total of 218 families.

[10] Included in this category were those who either had never been to school or had not passed beyond the third grade. It is, of course, understood that there may be many individual exceptions to this classification.

TABLE 4. NUMBER IN HOUSEHOLD OF TENANTS AND LABORERS ON 100 LOUISIANA SUGAR FARMS, BY TYPE OF TENURE AND COLOR

NUMBER IN HOUSEHOLD	Total		Resident Laborer		Share Cropper		Tenant	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
BOTH COLORS								
TOTAL HOUSEHOLDS...	328	100	242	100	24	100	62	100
Average Size of Households	4.7	...	4.3	...	5.7	...	6.1	...
1	4	1	3	1	...	...	1	2
2	68	21	63	26	1	4	4	6
3	55	17	52	22	1	4	2	3
4	50	15	36	15	6	25	8	13
5	34	10	22	9	4	17	8	13
6	43	13	22	9	5	21	16	26
7	30	9	17	7	4	17	9	15
8	21	6	17	7	1	4	3	5
9	9	3	4	2	...	...	5	8
10	6	2	3	1	1	4	2	3
11	2	1	...	...	...	...	2	3
12 and over	6	2	3	1	1	4	2	3
WHITE								
WHITE HOUSEHOLDS...	110	100	55	100	8	100	47	100
Average Size of Households	5.4	...	4.9	...	5.4	...	6.1	...
1	1	1	...	...	...	...	1	2
2	9	8	7	13	...	...	2	4
3	15	14	13	24	...	...	2	4
4	18	16	8	14	2	25	8	17
5	15	14	7	13	2	25	6	13
6	20	18	6	11	3	38	11	24
7	11	10	5	9	1	12	5	11
8	8	7	6	11	...	...	2	4
9	7	6	2	3	...	...	5	11
10	3	3	1	2	...	...	2	4
11	2	2	...	...	...	...	2	4
12 and over	1	1	...	...	...	...	1	2
NEGRO								
NEGRO HOUSEHOLDS..	218	100	187	100	16	100	15	100
Average Size of Households	4.4	...	4.1	...	5.9	...	6.1	...
1	3	1	3	2	...	...	...	...
2	59	27	56	30	1	6	2	13
3	40	18	39	21	1	6	...	...
4	32	15	28	15	4	25	...	...
5	19	9	15	8	2	13	2	13
6	23	11	16	8	2	13	5	33
7	19	9	12	6	3	19	4	27
8	13	6	11	6	1	6	1	7
9	2	1	2	1	...	...	...	...
10	3	1	2	1	1	6	...	...
11	...	...	...	...	...	...	...	...
12 and over	5	2	3	2	1	6	1	7

TABLE 5. GRADE ATTAINMENT OF FAMILY HEADS AND WIVES* LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY COLOR, 1936 (PERCENTAGES)

GRADES COMPLETED	TOTAL		WHITE		NEGRO	
	Heads	Wives	Heads	Wives	Heads	Wives
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
No Grade	45.8	36.7	40.0	38.5	48.8	35.8
1	9.0	7.7	8.2	7.3	9.4	8.0
2	13.6	12.5	9.1	9.4	16.0	13.9
3	8.1	8.7	9.1	6.3	7.5	10.0
4	10.8	12.8	11.8	14.6	10.3	11.9
5	4.6	9.4	8.2	8.3	2.8	9.9
6	3.1	4.7	4.5	6.3	2.4	4.0
7	2.5	3.7	4.5	1.0	1.4	5.0
8	1.9	2.4	3.7	6.3	0.9	0.5
9	0.6	0.7	0.9	1.0	0.5	0.5
10	.....	.....	.....	.....	.....	.....
11	.....	0.7	.....	1.0	.....	0.5

*Five of the 297 wives reporting were the heads of families. Four of the five had had no education and one had completed only the first year of school.

Forty-nine per cent of the Negro heads as compared with 40 per cent of the whites had never passed the first grade in school. Two-thirds of the whites and four-fifths of the Negroes had not gone beyond the third grade. In round numbers, 90 per cent of the Negro and 80 per cent of the white heads had not passed beyond the fourth grade.

The educational status of the wives was somewhat higher than that of their husbands at most grade levels. Nearly 10 per cent more wives than husbands had attended school, and comparatively more of them had completed each successive grade beyond the second. Despite the comparatively higher status, however, the educational attainment of the wives leaves much to be desired. Using the third grade as a general measure of literacy, two-thirds of them were illiterate and an additional 27 per cent had completed only the fourth, fifth or sixth grades.

Difference in education between white and Negro wives is small. Somewhat surprisingly, the data show a slightly greater proportion of white than of Negro wives not having passed the first grade. On the other hand, 93 per cent of the Negro wives as compared with 91 per cent of the white wives had not passed beyond the sixth grade. It should, of course, be observed, in comparing the educational attainments of whites and Negroes, that the number of grades passed offers only a rough index to actual attainment since the standards in the various schools vary greatly. But whatever may be the educational attainments of either race, it appears that little use is made of reading ability in either instance, as measured by current reading material found in the homes. Data from the 328 families under consideration show that only 5 of these households receive daily papers and 2 of them weekly papers.

INCOME OF RESIDENT LABORERS

Nature of the Work

The resident laborer, unlike the tenant or share cropper, works for wages rather than for a share of the crop. Aside from this his status is similar to that of the share cropper. In addition to money wages, he receives perquisites and his income is further supplemented by garden and livestock products.

The employment of the resident laborers was confined almost entirely to the farms on which they lived. Of the 242 reporting, only three reported having worked elsewhere during the past year and these at distances not exceeding three miles from their residences. Seasonal mobility was therefore almost negligible. In view of the low incomes and the intermittent employment on the farms during certain seasons, one might suspect a lack of ambition on the part of these laborers.[11] On the other hand, few jobs are available during the off seasons since the labor needs of the farms in the area are essentially identical and there is little else to offer eligible employment. The employment available on the farm on which he resides is about all that the resident laborer can count on or hope for.

The actual jobs on the sugar farm obtainable by the resident laborer are quite varied but are concentrated largely in the harvest and the planting and growing seasons (Table 6). More laborers report cutting cane than any other one particular job. Other major types of harvest season work reported were hauling, derrick, and factory work. The average days worked per year at these jobs was slightly under 75, excepting for the factory work, for which the average was 104 days. Although factory work is harvest season employment just as is hauling and derrick work, it extends over a slightly longer period since it comprises certain work around the sugar house both before and after the actual grinding season. Factory work also paid a slightly higher wage, $1.66 per day, than hauling, at $1.56 per day, derrick work, at $1.40 per day, and cutting cane, at $1.37 per day.

The planting and growing season work provides employment to the greatest numbers and for a greater period of time during the year than any of the other jobs. Of 242 laborers reporting, 205 reported this type of labor for an average of 145 days per person and at an average wage of 96 cents per day.

Certain other types of work reported, such as tractor driving, repair work, hostler, railroad work[12] and pipe fitting, are not confined either to

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[11] Nonresident laborers, whose work on the sugar farms is confined largely to cane cutting, work during off seasons in considerable numbers on cotton, rice and strawberry farms.

[12] Narrow-gauge railways are used on some of the larger plantations for hauling the cane from the fields to the sugar house.

TABLE 6. WAGES, DAYS WORKED AND TYPES OF JOBS OF 242 RESIDENT LABORERS, 1936

JOB	REPORTING SPECIFIC JOB	AVERAGE DAYS WORKED PER YEAR	AVERAGE DAYS WORKED PER MONTH	AVERAGE EARNINGS PER MONTH	AVERAGE EARNINCS PER DAY
	Number	Number	Number	Dollars	Dollars
Cutting Cane	106	74	25	34.56	1.37
Hoeing, Plowing, etc.	205	145	20	19.52	.96
Hauling	72	74	25	38.83	1.56
Driving Tractor	16	113	22	29.19	1.32
Factory Work	23	104	28	47.04	1.66
Ditching	36	69	20	20.00	.99
Derrick Work	12	72	26	35.83	1.40
Hoeing Cotton	3	42	18	16.67	.93
Picking Cotton	2	46	24	26.00	1.08
Cutting Rice	6	35	20	23.00	1.17
Grassing Rice	1	20	20	8.00	.40
Cleaning Land	2	105	21	32.50	1.55
Work in Corn	52	64	21	20.00	.96
Picking Moss, etc.	1	96	24	34.00	1.42
Cutting Hay. etc.	25	29	20	19.08	.94
Digging Potatoes	20	49	20	19.20	.95
Construction Work	1	144	16	20.00	1.25
Other Jobs	7	112	24	29.57	1.25
Repair Work	4	146	25	44.00	1.79
Hostler	7	284	27	24.00	.88
Foreman	11	161	23	34.00	1.46
Railroad Work	6	113	26	44.83	1.74
Pipe Fitter	2	186	26	38.00	1.46
Water Carrier	4	134	24	19.00	.81

the cutting or the cultivating season. A relatively small per cent of the total laborers reported these jobs but the average days per year employed for those reporting was relatively high.

Most of the resident laborers living on these farms were there as the result of their application to the operator. On the other hand, 24 out of the 242 reporting stated either that they had been born on the farm on which they were at present employed or that they had been living there since early childhood.

Family Income

Roughly three-fourths of the resident laborer families reported a gross cash income for the past year, including the contributions of wives and children, of from $250 to $500. Of the total families reporting, roughly 25 per cent had incomes of $250 to $300; 25 per cent incomes of $300 to $350, and 25 per cent incomes from $350 to $450. Approximately 7 per cent of the families had incomes of less than $250 and 20 per cent incomes of more than $450. Four per cent received $700 or more (Table 7).

Though there was little difference, white families had slightly larger incomes than Negro families. Slightly more of the Negro families had incomes of $250 or less and somewhat fewer had incomes of $500 or over.

TABLE 7. GROSS INCOME PER RESIDENT LABORER FAMILY, BY COLOR, 1936

GROSS INCOME PER FAMILY	BOTH COLORS		WHITE		NEGRO	
	Number	Per cent	Number	Per cent	Number	Per cent
TOTAL	242	100.0	55	100.0	187	100.0
$100-149	2	.8	1	1.8	1	.5
150-199	6	2.5	..	...	6	3.2
200-249	8	3.3	1	1.8	7	3.7
250-299	55	22.7	13	23.6	42	22.5
300-349	56	23.2	10	18.2	46	24.6
350-399	40	16.5	6	10.9	34	18.2
400-449	25	10.3	5	9.1	20	10.7
450-499	12	5.0	2	3.6	10	5.3
500-549	16	6.6	5	9.1	11	5.9
550-599	4	1.7	2	3.6	2	1.1
600-649	3	1.2	3	5.5	...	.....
650-699	5	2.1	3	5.5	2	1.1
700 and over	10	4.1	4	7.3	6	3.2

Several opposing tendencies affect this situation. As will be shown later, white heads had larger incomes than Negro heads, but members of the Negro families other than the head contributed more often than members of the white families.

Earnings of Family Head

The average earnings of the heads of the 242 resident laborer families for 1936 was $292. The average days worked was 257, giving an average daily wage of $1.14 (Table 8). Certain variations as between the nine parishes studied may be pointed out. Family heads in Lafourche Parish received the highest average earnings ($340), whereas those in Lafayette Parish received the lowest ($259). Laborers in Lafourche Parish worked a greater number of days (269) than those in Lafayette Parish (260), though this would account only in small part for this difference.

The average yearly earnings of the white laborers was $331 as compared with $281 for the colored. Here again the slightly greater number of days worked by the whites (265) than by the colored (255) may account to some extent for the difference in income.

Possibly a better way of picturing the labor income of the head of the resident laborer family is to state that roughly 75 per cent of these incomes fall within the range of from $250 to $350. The other 25 per cent are approximately equally divided above and below this range (Table 9). As between whites and Negroes, however, only 7 per cent of the whites as compared with 16 per cent of the Negroes fall below $250, and only 2 per cent of the Negroes as compared with 18 per cent of the whites receive more than $400. This difference in incomes of whites and Negroes is probably not due to discrimination against the Negro in the

TABLE 8. DAYS WORKED PER YEAR, EARNINGS PER YEAR AND PER DAY FOR RESIDENT LABORERS LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY PARISH AND COLOR, 1936

PARISH	BOTH COLORS				WHITE				NEGRO			
	Cases Reporting	Average Time Worked	Average Earnings Per Year	Average Earnings Per Day	Cases Reporting	Average Time Worked	Average Earnings Per Year	Average Earnings Per Day	Cases Reporting	Average Time Worked	Average Earnings Per Year	Average Earnings Per Day
	Number	Days	Dollars	Dollars	Number	Days	Dollars	Dollars	Number	Days	Dollars	Dollars
TOTAL	242	257	$292	$1.14	54	265	$331	$1.25	188	255	$281	$1.10
Assumption	58	271	332	1.22	19	277	364	1.31	39	222	316	.75
Iberia	20	259	274	1.06	5	268	272	1.02	15	257	275	1.07
Iberville	30	238	276	1.16	6	247	324	1.31	24	236	264	1.12
Lafayette	12	260	259	1.00	2	246	264	1.07	10	262	258	.98
Lafourche	19	269	340	1.26	10	261	361	1.38	9	278	316	1.14
Pointe Coupee	44	253	274	1.08	2	255	265	1.04	42	253	275	1.08
St. James	26	253	259	1.02	1	266	287	1.08	25	248	254	1.02
St. Mary	16	256	285	1.11	3	258	300	1.16	13	255	282	1.10
Terrebonne	17	247	284	1.15	6	249	286	1.14	11	245	283	1.15

TABLE 9. LABOR INCOME FOR HEAD OF RESIDENT LABORER FAMILY, BY COLOR, 1936

LABOR INCOME FOR HEAD	BOTH COLORS		WHITE		NEGRO	
	Number	Per cent	Number	Per cent	Number	Per cent
TOTAL	242	100.0	55	100.0	187	100.0
Under $100	1	.4	..	.....	1	.6
$100-149	7	2.9	1	1.8	6	3.2
150-199	6	2.5	..	.....	6	3.2
200-249	20	8.3	3	5.5	17	9.1
250-299	121	50.0	21	38.2	100	53.5
300-349	58	24.0	16	29.1	42	22.5
350-399	15	6.2	4	7.3	11	5.9
400-449	3	1.3	2	3.6	1	.5
450-499	3	1.2	2	3.6	1	.5
500-549	3	1.2	2	3.6	1	.5
550-599	2	.8	1	1.8	1	.5
600	2	.8	2	3.7	...	.....
Irrelevant	1	.4	1	1.8	...	.....

matter of wages for equal work, but may lie in the fact that the whites often have the more responsible jobs which demand a slightly higher wage.

Cash Earnings of Tenants and Croppers

Few of the tenant and cropper heads on the sugar cane farms received any cash wages during 1936. Of the 86 reporting, only 9 reported working for wages, the average amount earned being $178. Three of these 9 were share croppers who worked at cutting wood and in the cane and cotton fields with an average income of $39.

Two share tenants held jobs during all of 1936 for which they were paid cash wages, the one an assistant overseer who earned $288, and the other a blacksmith who earned $360 during the year. Other jobs reported by tenants were: school bus driver for nine months, $459; blacksmith and carpenter for six months, $160; part-time overseer for three months, $180; cutting cane, one month, $38.

Although only a few of the tenant and cropper heads worked on cash jobs, 67 per cent of the tenant families received contributions to the family budget from family labor other than the head (Table 10). The average amount earned by family members in 1936 was $166, or $31 more than that earned by members other than the head in the resident labor families.

This same situation obtained with respect to the Negro families as apart from the white. Members of the Negro tenant families contributed $143 as compared with $117 in the resident laborer families. This condition was reversed, however, in the white families, where the members of the tenant families contributed $185 as compared with $247 for the resident laborer families.

TABLE 10. CASH CONTRIBUTION OF ALL MEMBERS OTHER THAN HEAD OF TENANT AND LABORER FAMILIES LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY COLOR AND TYPE OF TENURE, 1936

TYPE OF TENURE	BOTH COLORS				WHITE				NEGRO			
	Reporting	One or More Contributing		Average Contributed	Reporting	One or More Contributing		Average Contributed	Reporting	One or More Contributing		Average Contributed
	Number	Number	Per cent	Dollars	Number	Number	Per cent	Dollars	Number	Number	Per cent	Dollars
TOTAL	328	224	68.3	$146.00	110	56	50.9	$211.00	218	168	77.1	$121.00
Resident Laborer	242	166	68.6	135.00	55	24	43.6	247.00	187	142	75.9	117.00
Tenant	86	58	67.4	166.00	55	32	58.2	185.00	31	26	83.9	143.00

Twenty-five per cent of the tenant families who had children between the ages of 10 and 15 received a cash contribution from the work of these children amounting to $62 per family. Of the 19 children making these contributions, 14 were boys and 5 were girls. Four of the five girls were colored.

Earnings of Wives

More than two-thirds of the resident laborer families had one or more members other than the head who contributed to the family income during 1936. Of those contributing, the average amount contributed was $135.

Negro wives and children contributed to the family earnings in a larger proportion of the families than the whites although their average contribution was less. Members of 76 per cent of the Negro laborers' families as compared with 44 per cent of the white laborers' families contributed to the family income, but the average contribution of the Negroes was $117 as compared with $247 for the whites.

Considering the contributions of the wives alone, it may be noted that slightly more than one-half of the wives of resident laborers contributed to the family income with an average amount of $56. Negro wives work in relatively much greater numbers than do white wives, and their contributions are also relatively greater. Only 9 per cent of the white wives contributed, as compared with more than 66 per cent of the Negro wives, the average addition to the family income for the white being $35, that for the Negro $57. This difference is partly accounted for by the great number of Negro women who cut cane during the harvest season.

Earnings of Children

Of the 244 laborer families reporting, 81 had children of from 10 to 15 years of age. Of these 81 families, 50 per cent had children who were making cash contributions to the family budget.[13] The contributions of these 52 children, for several of the families had more than one child of this age, made an average addition of $78 to the 41 family incomes. The bulk of these contributions came from the boys rather than the girls. Thirty-nine of the 52 contributors were boys, with an average contribution of $65 as compared with 13 from the girls with an average contribution of $51. All of the 13 girls were colored. White boys contributed with roughly the same relative frequency as colored boys, but the average contribution of the colored boys was $79 as compared with $58 for the white boys.

Roughly 50 per cent of the labor performed by these children was cutting cane, 15 per cent hoeing, and the remainder divided between jobs as water boy, house servant and odd jobs of various kinds. There seemed to be no marked difference in the type of jobs given white and colored children. The average days worked by white children was 50 as compared with 68 for the colored. This is reflected in the greater earnings of the colored children as stated above. The average days worked for both white and colored children was 64, and the average cash contribution was $62. This would indicate that the average daily wage is slightly less than $1.00.[14] This would appear to be a relatively high wage for children's labor in view of the adult wage scale. On the other hand, the bulk of this labor is performed during the harvest season when wages are highest and the need for laborers is greatest.

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[13] It should be borne in mind that these data represent a situation which obtained prior to the passage of the present child labor restrictions.

Method and Frequency of Wage Payment

Paydays are customarily two weeks apart, although a fifth of the laborers stated that they were paid every week. Less than 2 per cent were paid on a monthly basis.

More than 90 per cent of the 242 resident laborers interviewed stated that they were paid in cash for their work. The percentages reporting other methods of payment are as follows: check, 1 per cent; cash and order on store, 5 per cent; check and order on store, 3 per cent. Of the laborers paid in cash, roughly four out of ten resided on farms which did not maintain commissaries. Of the other six out of ten who did reside on farms with commissaries, 70 per cent reported that dealing with the commissary was compulsory. Hence, although the payment was made in cash, the laborer felt obliged to use his cash at the local commissary rather than elsewhere. The reasons for this varied. In some instances the operator had definitely stated that this was necessary. On the other hand, a number of the laborers felt that they were expected to trade at the commissary and hesitated to refuse to do so for fear of jeopardizing the security of their tenure or of disturbing the harmonious relationship that they now had with their employer. It has already been pointed out that essentially all of the employment received by the resident laborer comes from the farm on which he lives, and particularly during certain times of the year there is insufficient labor to go around. Hence, it is to the especial advantage of the laborer to keep on the best possible terms with his employer if he expects the maximum amount of work.

Probably as significant, however, as any compulsion which the laborer may feel from his employer, is the social compulsion resulting from his location with respect to other centers of trade. With few transportation facilities, the laborer is impelled by practical necessity to do most of his trading at the nearest store, and this store is usually the commissary of the farm on which he lives. It would seem fairly obvious, therefore, that from the standpoint of shopping about and making his dollar go the furthest, the average laborer is at a disadvantage. In some instances it appeared that the commissary prices were as good or better than could be obtained elsewhere. In these cases the laborer received the benefits of the good management of the operator. On the other hand, the average commissary under the setup of the typical sugar farm is not subject to the rugged competition which, for example, obtains among most village and city stores. The laborer, therefore, whose income is already low, should stretch the buying power of his dollar to the utmost. Under the present arrangement and in view of his own limited managerial ability, this possibility hardly seems likely in most cases.

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[14] This figure is only an approximation and should not be considered as an accurate statement of actual wages paid children.

Subsistence from Home Products

The growing of livestock and garden products by resident laborers and tenants on the sugar farms is done almost entirely for home consumption. Unfortunately such production is not as great as might be desired even for subsistence purposes. More than three-fourths of the 328 resident laborer and tenant families produce some livestock products, but in many instances such products consisted only of a few eggs for family consumption. Ninety-six per cent of the households reporting livestock products used their entire production in the home, and none of the families reported using less than one-half of their products for home consumption. Only two resident laborers reported selling products in the market, and the amount in each instance was under $5.00 for the entire year. Share croppers reported no livestock product sales at all. Eight tenants reported selling such products with an average amount of $16.50. None of the households reported selling milk.

Although admittedly a difficult task, an attempt was made to evaluate home consumed livestock products in terms of what these foodstuffs would have brought on the market. The average for the 173 households reporting such products was $40 (Table 11). For the nine parishes con-

TABLE 11. VALUE OF HOME PRODUCED PRODUCTS OF 242 RESIDENT LABORER HOUSEHOLDS LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY PARISH, 1936

PARISH	TOTAL REPORTING	REPORTING HOME PRODUCTS[1]		AVERAGE VALUE
	Number	Number	Per cent	Dollars
TOTAL	242	173	71.5	$40.00
Assumption	58	41	70.7	34.00
Iberia	20	17	85.0	34.00
Iberville	30	21	70.0	34.00
Lafayette	12	9	75.0	79.00
Lafourche	19	11	57.9	81.00
Pointe Coupee	44	35	79.5	24.00
St. James	26	17	65.0	24.00
St. Mary	16	13	81.0	66.00
Terrebonne	17	9	52.9	51.00

[1] Of the 173 resident laborer households reporting livestock products, all but two used all of the products in the home.

sidered, Lafayette ranked high with $79; and Pointe Coupee and St. James tied for low place with $24 each.

The three chief types of livestock which one might expect to find on the premises of the resident laborer are chickens, hogs and cows. Nearly three-fourths of the laborers had chickens, a fourth had cows and pigs.

As to the chickens, the flocks were small and the egg production mediocre. Six out of ten households reported a dozen chickens, and the majority of the remainder reported but two dozen. The largest flock reported was seven dozen. The average eggs produced and consumed was less than one dozen per week the year around, and only two households, one white and one colored, reported selling any eggs. White households reported a slightly better production of eggs than colored (Table 12).

Of the fourth of the households with cows, more than eight out of ten had only one, the remainder having two, with the exception of one household with four. As already stated, none of the households made a business of selling milk or butter. The average amount of milk used by those laborer families with cows was slightly over four gallons per week (Table 13).

Of the fourth of the households with pigs, seven out of ten had only one, the majority of the remainder had but two. The largest number reported by any one family was nine. In addition, 14 per cent of the families had fattening hogs. Eight out of ten of these had but one, and no family reported more than two. Roughly one-fifth of the households reported the production of lard, with an average of 31 pounds per year for the resident laborers (Table 14).

No beef cattle were reported, but 5 per cent of the families reported calves, nine out of ten of those reporting having one each. Eleven per cent reported heifers, nine out of ten having one each. Four per cent reported brood sows, all of those reporting having but one each.

The above presentation naturally raises the question as to why more animal products are not grown by these laborers. It would seem reasonable to suppose that at least sufficient should be produced for adequate home consumption. Yet such is not the case. The laborers were questioned as to the attitude of their employers with respect to raising livestock and vegetables for their own use. More than eight out of ten responded that their landlord encouraged such practices. The implication of these responses, however, is not entirely clear. Since a very high percentage of the landlords furnish their laborers garden space as a perquisite, it is plain that growing vegetables is usually encouraged. On the other hand, a number of the landlords object to livestock because of damage to crops, particularly if the chickens or stock are not cared for properly. In considering this matter several factors need to be taken into account: (1) inclination and ability of laborer to have and care for stock; (2) financial ability to acquire and facilities for caring for such

TABLE 12. NUMBER OF TENANTS AND RESIDENT LABORERS PRODUCING EGGS[1] ON 100 LOUISIANA SUGAR CANE FARMS AND AMOUNT USED, BY TYPE OF TENURE AND COLOR, 1936

TYPE OF TENURE	BOTH COLORS				WHITE				NEGRO			
	Households Reporting	Producing Eggs		Home Production Eggs Used	Households Reporting	Producing Eggs		Home Production Eggs Used	Households Reporting	Producing Eggs		Home Production Eggs Used
	Number	Number	Per cent	Number	Number	Number	Per cent	Number	Number	Number	Per cent	Number
TOTAL	328	244	74.4	69	110	94	85.5	108	218	150	68.8	44
Resident Worker	242	162	66.9	40	55	41	74.5	62	187	121	64.7	33
Share Cropper	24	23	95.8	78	8	8	100.0	82	16	15	93.7	75
Tenant	62	59	95.2	144	47	45	95.7	155	15	14	93.3	109

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[1] All of the share cropper, all but two of the resident laborer and all but eight of the tenant families used for home consumption all of the eggs produced.

TABLE 13. PER CENT OF TENANT AND RESIDENT LABORER HOUSEHOLDS PRODUCING MILK[1] ON 100 LOUISIANA SUGAR CANE FARMS AND AMOUNT USED, BY TYPE OF TENURE AND COLOR, 1936

TYPE OF TENURE	BOTH COLORS				WHITE				NEGRO			
	Households Reporting	Producing Milk		Home Production Milk Used	Households Reporting	Producing Milk		Home Production Milk Used	Households Reporting	Producing Milk		Home Production Milk Used
	Number	Number	Per cent	Gallons	Number	Number	Per cent	Gallons	Number	Number	Per cent	Gallons
TOTAL	328	102	31.1	279	110	66	60.0	303	218	36	16.5	233
Resident Worker	242	51	21.1	232	55	28	51.0	228	187	23	12.3	238
Share Cropper	24	11	45.8	281	8	5	62.5	358	16	6	37.5	216
Tenant	62	40	64.5	337	47	33	70.2	359	15	7	46.7	231

[1] All of the households reporting milk as a product of the farm, used the entire amount for home consumption.

TABLE 14. NUMBER OF TENANT AND RESIDENT LABORER HOUSEHOLDS ON 100 LOUISIANA SUGAR CANE FARMS WHICH PRODUCE LARD AND THE AMOUNT USED, BY TYPE OF TENURE AND COLOR, 1936

TYPE OF TENURE	BOTH COLORS				WHITE				NEGRO			
	Households Reporting	Produced Lard at Home		Home Production Lard Used	Households Reporting	Produced Lard at Home		Home Production Lard Used	Households Reporting	Produced Lard at Home		Home Production Lard Used
	Number	Number	Per cent	Pounds	Number	Number	Per cent	Pounds	Number	Number	Per cent	Pounds
TOTAL	328	93	28.4	47	110	37	33.6	67	218	56	25.7	34
Resident Laborer	242	43	17.8	31	55	7	12.7	43	187	36	19.3	29
Share Cropper	24	16	66.7	56	8	5	62.5	75	16	11	68.8	47
Tenant	62	34	54.8	62	47	25	53.2	72	15	9	60.0	36

stock; (3) cooperation of employer in giving permission and making possible the acquisition of necessary facilities.

The satisfactoriness of the situation depends finally on the ability of the employer and laborer to cooperate on these matters. If the laborer is disinclined or lacks the necessary ability to care for stock, the employer is helpless save for the possibility of educating the inclinations and abilities of his laborer over a period of time. Many employers have been doing this with good results over an extended period. On the other hand, a number of the resident laborers in the present study stated that they wished to raise livestock products but that they had no adequate place, no fence, or that, in general, the landlord did not encourage it. Some evidence along this line resulted from a question to each resident laborer as to whether he would rather be a regular laborer resident on a plantation, or whether he would rather be an independent laborer, working on the farm only during the rush season or other times when his services were specifically needed. In not a few cases the resident laborer responded that one of the definite advantages of the independent laborer, particularly if he owned his own house and plot of ground, was that he could grow more livestock and garden. The suggestion from this would seem to be that the initiative for growing more extensive garden and animal products is limited in many instances by the type of organization found on the sugar farms. One factor in this situation doubtless is that a too great dependence is often placed on the employer, which in turn stunts the initiative of the individual laborer to do things for himself. Then too, the laborer needs a considerable amount of guidance, since in the past he has not been in the habit of going ahead on his own. At any rate, it would seem that an added emphasis on producing products for home consumption by the resident laborer family would yield highly desirable results both to employer and employee.

TENURE AND OCCUPATIONAL HISTORY

Length of Residence

Resident laborers on the sugar cane farms moved relatively infrequently. Of the 242 resident laborers interviewed, the average length of residence on the present farm was 13 years, and the average number of farms they had lived on since working for themselves as apart from their parents was 2.5. They had been farming an average of 23 years (Table 15). Negroes were somewhat less mobile than whites. The average Negro resident laborer had lived 14 years on the present farm as compared with 9 years for the whites. This may be partially explained, however, from the fact that the Negroes had been farming slightly longer than the whites.

Although there are no considerable differences, the share croppers and tenants appear to be slightly more mobile than the resident laborers, as indicated by years on present farm. Also, the average number of farms

TABLE 15. NUMBER OF YEARS LABORER AND TENANT HOUSEHOLD HEAD HAS FARMED, NUMBER OF FARMS LIVED ON, YEARS ON PRESENT FARM, YEARS ON PRESENT FARM AT PRESENT STATUS, BY COLOR AND TYPE OF TENURE, 1936

TYPE OF TENURE	BOTH COLORS					WHITE					NEGRO				
	Cases Reporting	Years Farmed	Farms Lived On	Years On This Farm	Years Here At Above Status	Cases Reporting	Years Farmed	Farms Lived On	Years On This Farm	Years Here At Above Status	Cases Reporting	Years Farmed	Farms Lived On	Years On This Farm	Years Here At Above Status
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
TOTAL	328	23.7	2.6	12.3	10.4	110	23.0	2.7	10.6	9.1	218	24.0	2.5	13.1	11.1
Resident Laborer	242	22.8	2.5	12.6	11.0	55	21.5	2.7	9.3	8.8	187	23.0	2.5	13.6	11.7
Share Cropper	24	22.7	2.9	10.2	6.5	8	23.7	4.0	4.7	4.4	16	22.0	2.4	12.9	7.6
Tenant	62	27.4	2.7	11.8	9.5	47	25.8	2.6	13.0	10.2	15	32.0	2.9	8.0	7.1

lived on was slightly greater for both croppers and tenants than for the resident laborers. From the standpoint of race, Negro share croppers and tenants show definitely longer periods of residence on particular farms than whites.

Change in Tenure Status[15]

A contributing factor to length of residence of the resident laborer on a given farm is the fact that he seldom changes tenure status. Such a change of status might occasion a move, but 84 per cent of the resident laborers reported no change of tenure status since 1900 (Table 16). It

TABLE 16. Trend of Tenure Status 1900-1936 for 328 Tenants and Laborers Living on 100 Louisiana Sugar Cane Farms, by Type of Tenure and Color

Trend of Tenure Status[1]	Total		Resident Laborer		Share Cropper		Tenant	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Both Colors								
Total Both Colors	328	100.0	242	100.0	24	100.0	62	100.0
All Up	79[2]	24.1	23	9.5	14	58.3	42	67.7
Down	7	2.1	5	2.1	1	4.2	1	1.6
Both Up and Down	26	7.9	12	4.9	6	25.0	8	12.9
No Change	216	65.9	202	83.5	3	12.5	11	17.7
White								
Total White	110	100.0	55	100.0	8	100.0	47	100.0
All Up	42	38.2	5	9.1	5	62.5	32	68.1
Down	...	.....	..	.....	..	.....	..	.....
Both Up and Down	9	8.2	1	1.8	2	25.0	6	12.8
No Change	59	53.6	49	89.1	1	12.5	9	19.1
Negro								
Total Negro	218	100.0	187	100.0	16	100.0	15	100.0
All Up	37	17.0	18	9.6	9	56.3	10	66.7
Down	7	3.2	5	2.7	1	6.2	1	6.7
Both Up and Down	17	7.8	11	5.9	4	25.0	2	13.3
No Change	157	72.0	153	81.8	2	12.5	2	13.3

[1] The classes of tenure status as here used are from highest to lowest: owner, free of mortgage; owner, with mortgage; renter, cash or standing; renter, share or share-cash; share cropper; resident laborer; farm laborer; non-farm laborer.

[2] Most of these started at occupations other than farming. Hence roughly only 56 cases show a trend entirely upward if farming alone is considered.

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[15] The word "tenure" as used throughout this bulletin refers to man's relation to the land in the broadest sense. Every agricultural worker has some relation to the land, regardless of how tenuous it may be. Hence from this point of view it is proper to regard differences in various types of labor from the standpoint of tenure status.

should be pointed out in addition that a considerable number of the 16 per cent who reported a change in status have changed from casual farm work to the more permanent position of resident laborer. This, from the standpoint of the permanency of the job at least, constitutes an advancement. Two per cent of the 242 interviewed reported having moved down in status.

Possibly a better view of the relatively fixed class to which the resident laborer belongs may be had by pointing out that of the 280 heads of families who started out as laborers, 213 (76 per cent) still remain laborers. Twenty have become share croppers, 42 share tenants and 3 cash tenants. Of 28 who started out as common laborers in occupations other than sugar farming, 23 (82 per cent) had not progressed beyond the resident laborer stage. Additional evidence need not be given to make clear the point that resident laborers on sugar cane farms do not readily climb the tenure status ladder.

Resident laborer families now occupy this sturdily built old slave quarters.

The tenure trend of those who started out above the status of laborer shows also the infrequency of advance from a lower to a higher status in the tenure scale. Of the 328 tenants and laborers interviewed, one started out as an owner. His present status was that of share tenant. Of the fourteen who started out as share tenants, twelve still remain in this status, one had become a share cropper and one a laborer. Of the three who started out as share croppers, two remained in that status and one had become a cash tenant.

An analysis of the type of advance of 68 tenants and laborers who at some time had moved up in tenure status shows that the bulk of these advances was from laborer to share tenant. Of the 68 cases, the numbers making specified changes in status are as follows: Laborer to share tenant, 42; laborer to cropper, 19; laborer to cash tenant, 4; cropper to renter, 2;

renter to owner, 1.[16] From this it will be noted that all but three of the moves constituted a change from laborer to one of the more advanced classes.

Attitudes Toward Ownership

Apart from the analysis of the tenure history of these families, an attempt was made to determine something of their ambition relative to ownership. Of the total 328 families interviewed, nine out of ten stated that they preferred farm ownership to their present status. All but 2 per cent of the tenants indicated such a desire as compared with all but 13 per cent of the resident laborers. The significance of this difference is not clear other than the possible explanation that many of the laborers regard ownership for them as too remote to be included among their practical ambitions. Slightly fewer colored than white families expressed the desire to own a farm.

Although nine out of ten families wanted to own farms, only 5 per cent of them stated that they ever actually expected to do so. Among the tenants, one out of six expected to own a farm as compared with one out of fifty among the resident laborers. None of the 24 croppers reported the expectancy of ownership. Since those reporting expectancy of ownership are now largely tenants and since the preponderance of tenants are white, it is clear that the expectancy for the colored group is relatively low. On the other hand, of the 16 colored tenants, one out of four expected to become an owner as compared with one out of six of the 62 white tenants.

More than three-fourths of the families indicating a desire to own farms wished to do so because of the economic advantage assumed to be attached to farm ownership. Most of them spoke of this in terms of a better living. Of the other quarter, 13 per cent placed the major emphasis for their desire on more freedom in running their own affairs, 4 per cent on the possibility of a better garden under their own ownership, the remainder giving various other reasons.

PERQUISITES AND CREDIT

Type of Perquisites

In addition to their wages, all resident laborers reported receiving perquisites of one kind or another (Table 17). Eight out of every ten received a house, garden space, wood and a team for hauling the wood. Three out of every ten were furnished potatoes or some other vegetables. In the furnishing of vegetables, varied practices obtained. In some instances they were given outright. Occasionally the operator, with the help of his laborers, maintained a vegetable garden to which they might go for supplies. This type of arrangement was reported by something over one out of ten of the laborers. Milk was furnished in less than 1 per cent of the cases and eggs in slightly over 1 per cent.

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[16] This owner did not maintain his status.

TABLE 17. NUMBER AND PER CENT OF 328 TENANT AND RESIDENT LABORER HOUSEHOLDS REPORTING SPECIFIED PERQUISITES ON 100 LOUISIANA SUGAR CANE FARMS IN 1936, BY TENURE STATUS

PERQUISITE	ALL HOUSEHOLDS		RESIDENT LABORER HOUSEHOLDS		SHARE CROPPER HOUSEHOLDS		TENANT HOUSEHOLDS	
	Furnished Specified Perquisite		Furnished Specified Perquisite		Furnished Specified Perquisite		Furnished Specified Perquisite	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
TOTAL HOUSEHOLDS	328	100.0	242	100.0	24	100.0	62	100.0
House	325	99.1	242	100.0	24	100.0	59	95.2
Garden Space	259	79.0	199	82.2	24	100.0	36	58.1
Wood	253	77.1	197	81.4	13	54.2	43	69.4
Team for Hauling	214	65.2	189	78.1	19	79.2	6	9.7
Wagon	3	.9	2	.8	..	.....	1	1.6
Garden Tools	8	2.4	8	3.3	..	.....	..	....
Eggs	3	.9	3	1.2	..	.....	..	....
Milk	6	1.8	2	.8	2	8.3	2	3.2
Potatoes	63	19.2	56	23.1	4	16.7	3	4.8
Other Vegetables	23	7.0	23	9.5	..	.....	..	....
Vegetable Garden Furnished	32	9.8	32	13.2	..	.....	..	....

Somewhat of a historical perspective in the matter of perquisites may be had from the following quotation taken from a study made in 1900-1901, describing the situation at Cinclare Central Factory, West Baton Rouge Parish, Louisiana:[17]

> Each family is furnished with a cabin or portion of one, as the case may be, free of charge. . . . They are assigned a garden spot, and allowed the use of a mule on Saturday afternoons, and also the use of a wagon to haul wood, for which no charge is made. Sometimes wood is furnished free during the grinding season, as the laborers are needed for plantation work, and it is more profitable to have their labor and give them wood rather than lose their labor while they are cutting wood themselves. Some, however, prefer to buy their wood and seek to occupy their time in working their gardens; others are too lazy to work gardens.

The same study reveals somewhat different conditions at Calumet Plantation, St. Mary Parish, Louisiana:[18]

> The laborer is furnished with a house just the same as at Cinclare. . . . Each family has a garden about its house, but the people are discouraged from taking any land in the field, as they never raise anything upon it. Very few cultivate even the house gardens, though many of them spade and prepare the land. They rarely have enterprise enough to buy seed. These gardens are too small to warrant plowing. The owner does not permit the people to haul their own wood or to use the teams for any purposes except to do plantation work. After they have cut their wood it is hauled in for them by a special teamster at a charge of 15 cents per load if the wood comes from the plantation on which the people live, and 75 cents if they go to one of the owners of adjoining properties, or to any of the neighbors. Wood is never furnished free, but it is sometimes sold to the Negroes at cost. The factory hands work every Saturday afternoon and buy all their wood the year round. The laborers are paid in cash. Two stores are on the plantation, both rented out, which have to meet outside competition. The plantation also has a ration room. From this, dry salt shoulders, flour, and meal are issued on account to those who have neither money nor credit with which to buy at the stores of the neighborhood.

Value of Perquisites

The task of assigning accurate monetary value to perquisites is extremely difficult not only because of the difficulty of ascertaining the market values of the items in question but also because of the usual uncertainty of the exact quantity and quality of the items. Particularly difficult is the matter of arriving at proper estimates of the rental value of houses. Using local market prices as a basis, however, and in consultation with the laborers themselves, the following estimates as to the total value of perquisites received during the past year were arrived at: resident laborers, $39;[19] share croppers, $64; tenants, $62; average for all three classes, $45. Negroes received an estimated average of $37 as compared with $61 for the whites.

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[17] J. Bradford Laws, *op. cit.*, p. 110.

[18] *Ibid.*, p. 111.

[19] For further discussion of perquisites given resident laborers, see the author's bulletin, *The Sugar Cane Farm—A Social Study of Labor and Tenancy*, Louisiana State University Agricultural Experiment Station Bulletin No. 320, University, Louisiana, 1940. The average value of perquisites as estimated by 74 operators for their 898 resident laborer families was $69. House rental was the chief item causing this figure to be considerably higher than that quoted above. The monthly rental value assigned by the operator was in a great many instances considerably higher than that assigned by the laborer.

Consideration was given to the perquisites given resident laborers on the various sizes of farms, but no conclusive trend in this regard was evident. The lowest values reported were for the farms with less than 50 acres in cane ($37) and those with from 1,000 to 5,000 acres ($35), but in the former group only four cases reported. The very largest farms, with 5,000 or more acres of cane, show a value of $42, which is somewhat above the average. The value of perquisites to Negro families is consistently lower on all sizes of farms and shows but slight variation, the lowest being $33 for the 87 families living on farms with from 1,000 to 5,000 acres of cane and the highest ($40) for the 12 families living on farms with from 260 to 500 acres of cane. On the other hand, the range of the white families is from $37 to $68.

The largest item in the perquisite value was that of house rental which, as estimated, averaged $25 a year for the resident laborers. Negro houses were frequently poorer than those occupied by the whites, the average estimated annual rental value of the former being $22 as compared with $34 for the whites.[20] Share cropper and tenant houses were rated somewhat higher than those of the resident laborers, the average annual rental value for the cropper being $36 and that of the tenant $50. Here again the white houses were rated somewhat higher than the Negro: average annual rental value, white, cropper, $43; tenant, $56; average annual rental value, Negro, cropper, $33; tenant, $31.

Possibly the next most important perquisite item is that of wood. Roughly eight out of ten of the 328 resident laborer, tenant and cropper families were furnished wood, with an average value assigned of $5.70. This did not include hauling, since this was usually done by the laborer himself, and in most cases, particularly with the resident laborers and croppers, with the operator's team. In a great many instances, this wood was available on the operator's farm and was to be had for working it up and hauling it. Frequently, some sort of a deal was arranged between the operator and the laborer whereby the operator got all or a part of the wood for his own personal use worked up by the laborer for the use of the equipment the laborer used in getting his own wood. The most usual amount of wood furnished by the operator to the laborers, croppers and tenants was from 7 to 10 cords. Two hundred fifty-three of the total 328 households reported having wood furnished, the percentages of these households receiving specified amounts being as follows: 5 cords or less, 9 per cent; 6 cords, 11 per cent; 7 to 10 cords, 43 per cent; 11 to 14 cords,

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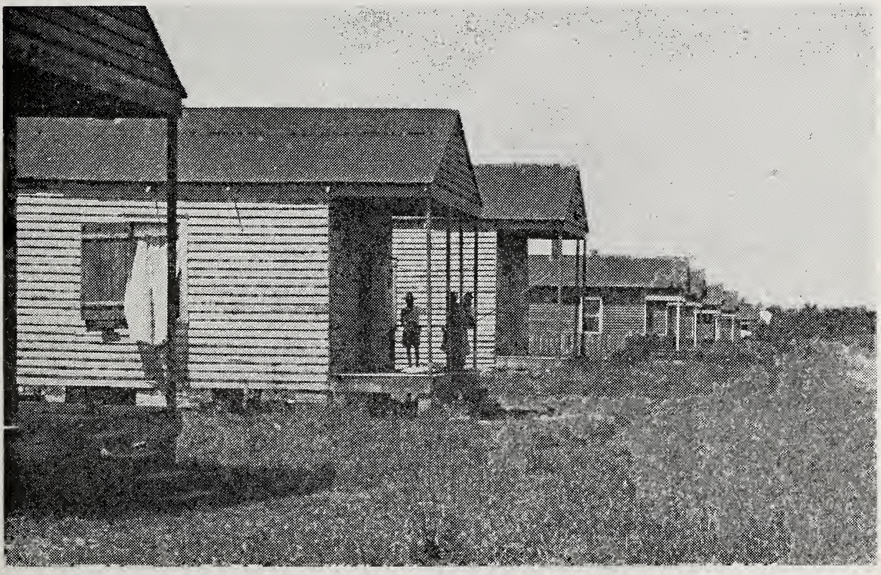
[20] Although comparable data are not available for Louisiana, sample studies made in 1935-36 by the U. S. Departments of Labor and Agriculture valued housing accommodations of agricultural laborers in Mississippi at about the same rate. The following valuations were presented: white share croppers, $30; Negro share croppers, $21. (O. E. Baker, Ralph Borsodi and M. L. Wilson, *Agriculture in Modern Life,* Harper and Bros., New York, 1939, p. 285.)

19 per cent; 15 cords and over, 18 per cent. The value of the wood was figured roughly at 50 cents per cord, exclusive of hauling.

Approximately eight out of ten of all resident laborers and croppers were furnished teams for hauling their wood and for other similar items. Among the tenants, only 10 per cent reported being furnished a team, since naturally most of them had teams of their own. The average value assigned for the annual use of these teams was $3.20. Here again there is no suitable way of arriving at the value of this item. Many operators have estimated it at a figure much higher than the above. On the other hand, a number of the laborers claimed that they earned their use of the team by free labor which they gave the operator. The essential fact is that most of the operators do allow the use of a team to their laborers for hauling up their wood and possibly some garden work. These services are necessary to the laborer and could be obtained only with considerable difficulty, if at all, were they not furnished by the operator. Yet they actually cost the operator relatively little. The situation, therefore, becomes one of cooperative relationship between the operator and his laborer, and it may be seriously questioned whether it is possible to arrive at a correct financial evaluation of this, or whether in fact it is relevant to speak of it in such terms.

Other items such as garden space and the furnishing of vegetables come in somewhat the same category. The average annual rental value of the



This operator left off repairing his resident laborer cabins when his income was cut. Note the painted cabins in the rear with screened windows, remodelled porches, and wooden fences as compared with the wooden-shuttered, unpainted cabins in the foreground.

garden space which was furnished eight out of ten of the households was estimated to be $3.00. Two out of ten of the households were furnished potatoes at an average value of $6.50, and slightly under one-tenth of the households were furnished other vegetables at an average value of $5.10.

Number Receiving Credit Advances

Nine out of ten of the laborers, tenants and croppers received credit advances in 1936 (Table 18). Of these, slightly over one-half received the credit from their landlord, a fourth from a merchant, and a small number from both landlord and merchant. Six per cent, all of whom were tenants, received credit from other sources (see footnote, Table 18).

TABLE 18. SOURCE OF CREDIT IN 1936 OF TENANTS AND RESIDENT LABORERS LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY TENURE STATUS AND COLOR

SOURCE OF CREDIT	Total		Resident Laborer		Share Cropper		Tenant	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
BOTH COLORS								
TOTAL BOTH COLORS..	328	100	242	100	24	100	62	100
Used No Credit..........	44	13	31	13	3	13	10	16
Landlord[1]...............	175	53	148	61	12	50	15	24
Merchant...............	81	25	62	26	7	29	12	19
Landlord and Merchant...	9	3	1	...	2	8	6	10
Other[2].................	19	6	...	...	...	...	19	31
WHITE								
TOTAL WHITE........	110	100	55	100	8	100	47	100
Used no Credit..........	24	22	13	24	2	25	9	19
Landlord[1]...............	33	30	21	38	2	25	10	21
Merchant...............	30	27	20	36	4	50	6	13
Landlord and Merchant...	7	6	1	2	...	...	6	13
Other[2].................	16	15	...	...	...	...	16	34
NEGRO								
TOTAL NEGRO........	218	100	187	100	16	100	15	100
Used No Credit..........	20	9	18	10	1	6	1	7
Landlord[1]...............	142	65	127	68	10	63	5	33
Merchant...............	51	23	42	22	3	19	6	40
Landlord and Merchant...	2	1	...	...	2	12	...	...
Other[2]..	3	2	...	...	...	...	3	20

[1] Two of the 15 tenants reporting that they received credit from their landlord also received credit from the South Louisiana Production Credit Association.

[2] This category includes the following: South Louisiana Production Credit Association, 6; Resettlement Administration, 4; State Agricultural Credit Corporation, 3; Opelousas Production Credit Association, 3; Rural Rehabilitation, 1; private individual, 1; and bank, 1. Three of those receiving credit from the Resettlement Administration were Negroes.

The source of credit advance differed somewhat as between the three tenure groups: Almost two-thirds of the resident laborers, as compared with one-half of the croppers and less than one-fourth of the tenants, received credit from their landlords. Slightly more than one-fourth of resident laborer and cropper families received credit from store merchants. Almost one-third of the tenants received all of their credit from sources other than landlords or merchants.

Of the 242 resident laborers, only 31, or 13 per cent, used no credit at all. Less than 10 per cent of the Negroes used no credit, as compared with 24 per cent of the whites. Also, the Negro laborers depended more largely on their landlords for credit than did the whites. Sixty-eight per cent of the Negroes received credit from their landlords as compared with 38 per cent of the whites.

Amount and Frequency of Credit Advances

An average advance of $149 was extended the resident laborers in 1936 (Table 19). Of these, 38 were extended less than $100 and 2 more than

TABLE 19. AMOUNT OF ADVANCE EXTENDED TO RESIDENT LABORER AND TENANT HOUSEHOLDS LIVING ON 100 LOUISIANA SUGAR CANE FARMS IN 1936, BY TYPE OF TENURE AND COLOR

TYPE OF TENURE	TOTAL HOUSEHOLDS REPORTING	REPORTING ADVANCE			NUMBER REPORTING SPECIFIED ADVANCE				
		Number	Per cent	Average Advance	Under $100	100-150	151-200	201-299	300+
BOTH COLORS									
TOTAL......	328	284	86.6	$328.23	43	102	59	43	37
Resident Laborer.	242	211	87.2	148.67	38	89	52	30	2
Share Cropper...	24	21	87.5	264.90	..	8	4	4	5
Tenant..........	62	52	83.9	1082.44	5	5	3	9	30
WHITE									
WHITE......	110	86	78.2	699.63	5	22	12	17	30
Resident Laborer.	55	42	76.4	184.14	2	16	11	11	2
Share Cropper...	8	6	75.0	222.50	..	3	..	2	1
Tenant..........	47	38	80.9	1344.70	3	3	1	4	27
NEGRO									
NEGRO	218	198	90.8	166.92	38	80	47	26	7
Resident Laborer.	187	169	90.4	139.80	36	73	41	19	..
Share Cropper...	16	15	93.8	281.86	..	5	4	2	4
Tenant..........	15	14	93.3	370.57	2	2	2	5	3

$300. Advances to Negro resident laborers averaged $140 as compared with $184 for whites. Most of the landlord[21] advances to resident laborers were either for two-week periods or for between paydays, the bulk of the remainder being on a monthly basis. With the exception of one share cropper who received monthly advances and one tenant who received advances between paydays, all of the share croppers and tenants received their advances on a yearly basis. There was little difference in frequency of advances between white and colored households.

The above figures represent cumulative advances for the period of the year. Hence, the amount which the laborer was indebted at any one time was not likely to be much in excess of the amount of his wages for the two weeks or other given period between his paydays. During the slack season, however, the laborers frequently ran somewhat behind in their finances. When this occurs payment is usually made in full during the next harvest season, when work is plentiful and wages higher.

Indebtedness for Old Advances

Roughly 10 per cent of the resident laborers reported that they were indebted for old advances[22] which they had received. The average of such old debts was $7.50. Of the 27 reporting such debts, 3 of the debts were under $5.00, 21 from $5.00 to $10.00, and 3 over $10.00. From this it will be seen that these advances are kept pretty well paid up. In issuing the advance the operator commonly bases it on the labor value of the individual in question. That is to say, he extends the credit at such time as it is needed, but usually in keeping with the labor value of the individual. Consequently, outside of unusual occurrences, the operator usually gets his money back. Then too, as has already been pointed out, the amount which the operator has out at any one time to a particular individual is usually not very great.

Form of Advance

Of the 211 resident laborers receiving advances, 203, or more than 96 per cent, received their advances through store orders. Of these 203 families, 141 lived on farms where there was a commissary. In the case of these 141 families, approximately 95 per cent stated that their advance was through the commissary. The bulk of the remaining 5 per cent stated that they received no advance. Hence the amount of advance, spoken of in preceding paragraphs, usually represents an amount of store credit rather than actual cash. Also, the credit in roughly two-thirds of these cases came through the commissary and in the other one-third of the cases from stores not on the farm in question (Table 20).

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[21] Advances made by merchants differed little in frequency or amount from those made by the landlords. Of the 63 resident laborer households reporting advances from merchants, 8 per cent were usually made on a weekly basis; 24 per cent semi-monthly; 29 per cent monthly; and 40 per cent between paydays.

[22] Usually interpreted to mean debts which have run over a harvest season.

TABLE 20. FORM OF ADVANCE EXTENDED 160 TENANT AND RESIDENT LABORER FAMILIES WHO REPORT THAT LANDLORD HAS COMMISSARY, BY TYPE OF TENURE

FORM OF ADVANCE	TOTAL		RESIDENT LABORER		TENANT	
	Number	Per cent	Number	Per cent	Number	Per cent
TOTAL	160	100.0	141	100.0	19	100.0
Commissary	141	88.1	133	94.3	8	42.1
Cash	6	3.8	1	.7	5	26.3
Cash and Credit	7	4.3	2	1.4	5	26.3
None	6	3.8	5	3.6	1	5.3

Previously a statement was made relative to the obligation which laborers felt to trade in the commissary of the farm on which they resided. It may readily be seen that such patronage becomes largely compulsory where the laborer received credit through the commissary. Hence, when two-thirds of the resident laborers residing on farms maintaining commissaries reported that dealing with these commissaries was compulsory, it is fairly clear that such would of necessity be the situation where credit was extended through the commissary. Of the share croppers living on the farms with commissaries, 70 per cent, as compared with 33 per cent of tenants, stated that trading in the commissary was compulsory. There was no significant difference in this regard as between the races for any of the tenure classes.

SOCIAL AND ECONOMIC RELATIONS TO LANDLORD

Dependence in Emergency

Since most people are dependent on each other in one way or another, it is not surprising that eight out of ten of the families interviewed indicated dependence on an outside source in case of emergency. The source of this help offers a significant index to the social and economic alignments of these agricultural workers.

That croppers and tenants reported less outside dependence than laborers may be partially ascribed to the better economic status of the former groups. On the other hand, interdependency, particularly of the cooperative type, may be regarded as a mark of cultural advancement. A distinction should be made, however, between spontaneous cooperation by the relatively equal members of a group, and the state of servile dependency which frequently characterizes the position of the laborer in the so-called cooperative relation with his landlord. This latter relation has little of cooperative self-help in it and its effect is likely to be that of throttling initiative and further intensifying a one-sided dependence on the landlord's help.

From the standpoint of self-help, that is, the attempt to work out some of their own problems rather than to refer them to the charity of the landlord, the Negro in some respects seems to have made a better adjustment than the white (Table 21). Although an essentially equal number, 56 per cent of the whites and 58 per cent of the Negroes, reported dependence on their landlords, it is worthy of note that 36 per cent of the Negroes as compared with only 24 per cent of the whites reported partial dependence on insurance. It need scarcely be pointed out that dependency on insurance, which essentially is a cooperative effort on the part of those belonging to the insurance group and which really amounts to self-help, is of a distinctly different order than dependence upon the uncertainties of charitable help from another person. A pre-

TABLE 21. Outside Sources Depended on in an Emergency by Tenants and Larorers Living on 100 Louisiana Sugar Cane Farms, by Type of Tenure and Color

Source	Total		Resident Laborer		Share Cropper		Tenant	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Both Colors								
Total Both Colors	328	100	242	100	24	100	62	100
No One	53	16	17	7	5	21	31	50
Landlord	163	50	140	58	10	42	13	21
Insurance	108	33	84	35	7	29	17	27
Relatives and Other	4	1	1	*	2	8	1	2
White								
Total White	110	100	55	100	8	100	47	100
No One	35	32	11	20	2	25	22	46
Landlord	45	41	31	56	2	25	12	26
Insurance	29	26	13	24	4	50	12	26
Relatives and Other	1	1	...	...	...	...	1	2
Negro								
Total Negro	218	100	187	100	16	100	15	100
No One	18	8	6	3	3	19	9	60
Landlord	118	54	109	58	8	50	1	7
Insurance	79	36	71	38	3	19	5	33
Relatives and Other	3	2	1	1	2	12	...	...

*Less than .5 per cent.

vious report on this study pointed out that operators felt a definite responsibility of "looking after" the families living on their respective farms.[23] The motives of the individual operators in assuming this attitude need not be questioned. On the other hand, a social custom which in any way stunts the initiative of the individual or keeps him from doing the utmost that he can for himself, is likely in the long run to be detrimental to all parties concerned. Present attitudes in this matter are dictated largely by immediate needs. That is to say, under the present situation, many workers are in need of paternalistic protection and the operators are in a position to give it. Granted that this is correct, it may still be maintained that the social goal might well be the alleviation whenever and wherever possible of the one-sided dependency of any group upon another group or individual and the substitution therefor of as much individual initiative and self-direction as is compatible with cooperative relationships.

Emergency Loans

Although six out of ten of the resident laborers interviewed stated that they depended on their landlords in times of emergency, less than three-fourths had ever received such emergency loans (Table 22). It is, of course, to be understood that the dependency mentioned may have taken forms other than financial loans. A somewhat greater proportion of resident laborers than croppers or tenants reported financial emergency loans.

The proportion of whites and Negroes receiving emergency loans from their landlords was approximately the same, the percentages being 44 for the whites and 43 for the Negroes. Among the share croppers 13 per cent of the whites as compared with 19 per cent of the Negroes stated that they had received loans.

Recency of Loans

In order to obtain some measure of the frequency of emergency loans from the landlord, each worker who had received such loans was asked how recently he had received such aid. The results indicate considerable differences as between individual families. Of the 55 resident laborer families reporting, roughly one-third indicated that they had received a loan during the past six months, another third stated that it had been from six months to a year, and approximately a fifth stated that it had been from one to two years ago. Approximately 15 per cent stated that it had been from two to five years since they had received such aid.

Repayment of Loans

Emergency loans made to resident laborers by landlords were reported to have been paid in 93 per cent of the cases. Negroes reported payment in 95 per cent of the cases as compared with 88 per cent for the whites.

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[23] Harold Hoffsommer, *op. cit.*, p. 61.

TABLE 22. DEPENDENCE UPON LANDLORD OF RESIDENT LABORER AND TENANT FAMILIES LIVING ON 100 LOUISIANA SUGAR CANE FARMS, BY TENURE AND COLOR

TYPE OF TENURE	BOTH COLORS			WHITE			NEGRO		
	Reporting Dependence on Landlord	Receiving Emergency Loans From Landlord		Reporting Dependence on Landlord	Receiving Emergency Loans From Landlord		Reporting Dependence on Landlord	Receiving Emergency Loans From Landlord	
	Number	Number	Per cent	Number	Number	Per cent	Number	Number	Per cent
TOTAL	163	115	70.6	45	31	68.9	118	84	71.2
Resident Laborer	140	104	74.3	31	24	77.4	109	80	73.4
Share Cropper	10	4	40.0	2	1	50.0	8	3	37.5
Tenant	13	7	53.8	12	6	50.0	1	1	100.0

Seven out of ten of these loans were repaid with labor, the remainder in cash. There was no significant variation as between whites and Negroes in this regard. There appears to be a tendency for the loans to be paid in cash on the larger farms to a greater extent than on the smaller ones, although the number of cases is not sufficient to justify a definite statement. Of eight cases located on farms with less than 175 acres of cane, only one loan was repaid in cash, whereas of 53 cases on farms with more than 1,000 acres of cane, 22 loans were repaid in cash.

HOUSING AND HOME CONVENIENCES

Type of House

As previously stated, resident laborers are furnished their houses as perquisites by the farm operators. These houses are usually small, single-walled, unceiled, frame dwellings. Many of them are equipped with hinged, wooden shutters instead of windows, and few of them are screened. Although they are ordinarily built to house a single family, in some instances they are constructed to accommodate two or more families. The great bulk of the cottages are unpainted, though some of them show evidences of more or less recent applications of whitewash. Owners frequently indicated that they should like to provide their laborers with more satisfactory houses if they could afford to do so. The houses of a given farm are usually clustered along a road or lane in the vicinity of the operator's residence. Share croppers and tenant houses are in general somewhat larger and more desirable than those of the resident laborers.

Only slightly more than one-third of the houses visited had windows with glass, most of them having hinged, wooden shutters instead. Roughly seven out of ten of the croppers and tenants had glass windows in their houses, but less than three out of ten of the resident laborers' houses were so equipped.

A comparison of white and Negro houses reveals that a much greater proportion of the white houses (69 per cent) had glass windows than did the Negro houses (18 per cent). As would be expected from the figures presented above, among the whites and Negroes, tenants and share croppers had considerably higher averages of glass windows than did the resident laborers.

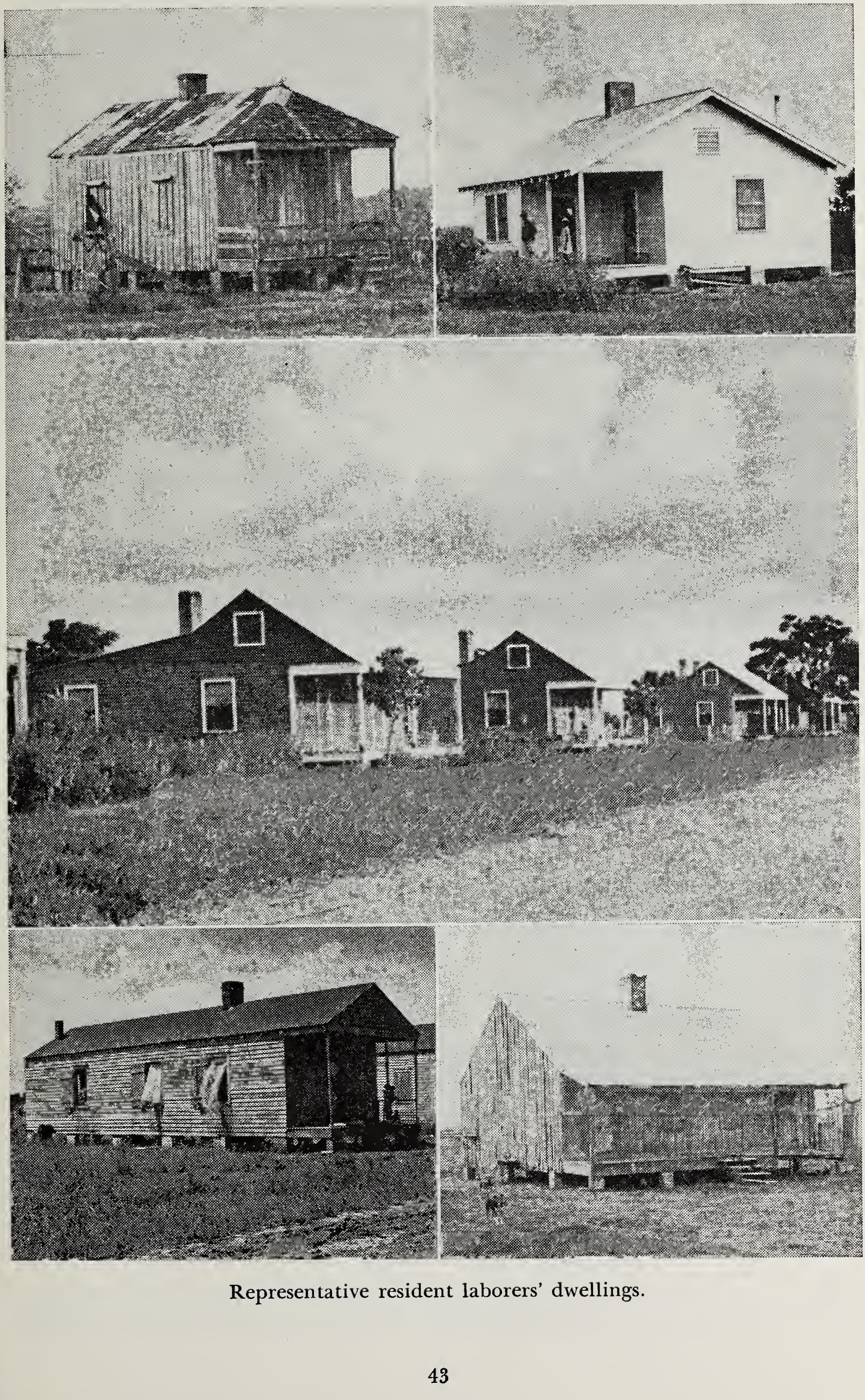
As regards screening, fewer screened windows are evident in the area than glass windows. Of the entire number of families interviewed, only slightly over 18 per cent reported screened windows, regardless of the number or condition of the screens. Of the racial groups, 6 per cent of the Negro houses had screened windows as compared with 42 per cent of the whites' houses, though it will be recalled that the whites constitute only about a third of the labor force in the sugar plantation area. On individual houses, whites averaged over twice as many screened windows as did Negroes.

Size of House

The most common laborer house consisted of two rooms (Table 23). Next in order of frequence were three-room, four-room, five-room, one-room and six-room houses. Of the 10 families out of the total of 242 under consideration living in one-room houses, all were Negro. As a matter of general observation, it might be said that the Negro houses were usually not as desirable as those of the whites. The average Negro house with 2.8 rooms averaged slightly more than one room smaller than the average white house with 3.9 rooms. Roughly four out of ten of all Negroes lived in two-room houses, as compared with less than one out of ten of the whites. Share croppers and tenants lived in larger houses than resident laborers but here again the whites had somewhat larger houses, averaging for the whites slightly over five rooms per house and for the Negroes less than three rooms per house. Most of these houses had porches of some

TABLE 23. NUMBER OF ROOMS IN HOUSES OF LOUISIANA SUGAR FARM RESIDENTS, BY TENURE AND COLOR, 1936

TYPE OF TENURE	Households Reporting	Average Rooms	Houses Having Specified Number of Rooms					
			1	2	3	4	5	6
BOTH COLORS								
TOTAL BOTH COLORS								
Number	328	3.4	10	85	88	86	37	22
Per cent	100.0	...	3.1	25.9	26.8	26.2	11.3	6.7
Resident Laborer	242	3.0	10	80	74	51	21	6
Share Cropper	24	3.9	....	5	6	6	5	2
Tenant	62	4.8	....	....	8	29	11	14
WHITE								
TOTAL WHITE								
Number	110	4.6	....	4	21	38	27	20
Per cent	100.0	...	....	3.6	19.1	34.5	24.6	18.2
Resident Laborer	55	3.9	....	4	17	16	13	5
Share Cropper	8	5.4	....	....	....	3	4	1
Tenant	47	5.1	....	....	4	19	10	14
NEGRO								
TOTAL NEGRO								
Number	218	2.9	10	81	67	48	10	2
Per cent	100.0	...	4.6	37.2	30.7	22.0	4.6	.9
Resident Laborer	187	2.8	10	76	57	35	8	1
Share Cropper	16	3.2	....	5	6	3	1	1
Tenant	15	3.8	....	....	4	10	1	....



Representative resident laborers' dwellings.

kind, but in the sample of 242 resident laborers' houses none was screened. Likewise, none of the cropper houses had screened porches, and only three of the tenant houses, all of which were occupied by white tenants, had screened porches.

Home Conveniences

As used in this study, the term "home convenience" includes such items as telephone, radio, sewing machine and phonograph, as well as bath tubs, running water and electricity. Of these items, the convenience possessed most frequently by the resident laborer and tenant families was the sewing machine. More than one-half of the families possessed sewing machines. Differences existed, however, between the various tenure groups. Among the tenant families, 97 per cent owned machines as compared with roughly two-thirds among the share croppers and slightly over one-third of the resident laborers. The greater proportion of the machines were possessed by white families, only 3 per cent being without machines as contrasted with 65 per cent among the Negroes.

From the economic as well as the convenience standpoint, probably the sewing machine should be regarded as a necessity in the rural home. This may explain its relative frequency. Of the other items, only the ice box and the phonograph were found in appreciable numbers, 14 per cent of the families reporting ownership of each. Five per cent reported radios, 4 per cent electricity, and smaller percentages running water, bath tubs, telephone or daily or weekly papers. Among the Negro families none reported any of the above items other than sewing machine, ice box and phonograph. Among the white families, these three items were the only ones possessed by any of the share croppers.

The conventional wood stove used throughout the rural South furnished the cooking medium for more than nine out of ten of the families. Of the 20 families having other facilities, 19 utilized oil stoves, the remaining family (colored) using a fireplace. Sixteen of the 20 families were white, and all but three of them were in the resident laborer group.

Forty per cent of the families obtained their drinking water from pump wells, roughly 25 per cent each from cisterns and tanks, 5 per cent from hydrants and 2 per cent from the river. The extreme difficulty of getting good water from wells in this section doubtless accounts for the large percentage using cisterns and tanks. Among the resident laborers, 37 per cent obtained their water from pump wells, 35 per cent from tanks, 21 per cent from cisterns, 5 per cent from hydrants and 2 per cent from the river. Of the total of eight families obtaining drinking water from the river, five were resident laborers, three were share croppers, but all were colored. Ten of the 328 families had running water in the house.

COMMUNITY RELATIONS

The community life of the resident laborer families of the "Sugar Bowl," as in other rural areas of the deep South, is centered about churches and trade centers, visits with friends and relatives, and attendance at meetings of various social and fraternal organizations. The more formal aspects of the social life of the people can be measured by the extent to which family members participate in these activities. Informal group activities, though equally or even more important than those in formal groups, are less tangible and much more difficult of analysis. Such day-by-day acts as gossiping in the field or borrowing of household articles or commodities, while constituting the very essence of group living, do not easily lend themselves to analysis. Though such activities are not examined in this study, their presence and importance are fully recognized.

Church Attendance

Of the formal community activities, attendance at church was by far the most important. Ninety-four per cent of the entire group of families stated that one or more of their members regularly attended church (Table 24). There was practically no tenure or racial variation in this regard, no one group having over 7 per cent of its members who did not attend church. This high attendance rate is probably largely accounted for by the community as well as the religious aspect of the church. For the people look upon church services as an occasion for meeting and talking with acquaintances and friends as well as an opportunity for religious service.[24]

Fraternal Organizations

Next to church meetings, those of fraternal organizations were most frequently attended. More than 60 per cent of the people interviewed belonged to such organizations. As in the case of churches, there were few racial or tenure variations in membership, with one exception. A greater proportion of tenants, both white and colored, than of any other tenure group belonged to such organizations. The higher economic status of these individuals probably accounts for this larger membership. Almost all of these societies were affiliated with sickness and burial insurance companies. As in the case of the church services, meetings afford an opportunity for informal visiting and talking, apart from the official business of the meeting.

Movies and Entertainments

Approximately 17 per cent of the households interviewed reported attendance at motion picture shows. Considerable racial and tenure differences were evident in this activity. Thirty-seven per cent of the whites and 7 per cent of the Negroes reported attendance. For the

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[24] Laws, *op. cit.*, contends that the church represents the only expression of group life for the workers and explains that it is the only place where they can get together (in a group) and tal kthings over. While an extreme view, it is probable that the importance of the rural church as a social organization has been generally under emphasized.

TABLE 24. PARTICIPATION IN SOCIAL ORGANIZATIONS OF 328 TENANT AND LABORER HOUSEHOLDS LIVING ON LOUISIANA SUGAR CANE FARMS, BY TENURE STATUS AND COLOR, 1936

ACTIVITY PARTICIPATED IN	Reporting Participation							
	Total		Resident Laborer		Share Cropper		Tenant	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
BOTH COLORS								
Church	308	94	226	93	23	96	59	95
Socials	33	10	24	10	1	4	8	13
Movies	57	17	31	13	4	17	22	36
Dances	39	12	18	7	4	17	17	27
Entertainments	53	16	36	15	2	8	15	24
Fraternal Organizations	206	63	147	61	15	63	44	71
Visit Friends and Relatives	194	59	144	60	14	58	36	58
WHITE								
Church	104	94	51	93	8	100	45	96
Socials	21	19	12	22	1	13	8	17
Movies	41	37	18	33	3	38	20	43
Dances	32	29	16	29	2	25	14	30
Entertainments	28	25	13	24	2	25	13	28
Fraternal Organizations	71	64	33	60	5	63	33	70
Visit Friends and Relatives	69	63	37	67	6	75	26	55
NEGRO								
Church	204	94	175	94	15	94	14	93
Socials	12	5	12	6	...	...	...	...
Movies	16	7	13	7	11	6	2	13
Dances	7	32	2	1	2	13	3	20
Entertainments	25	11	23	12	...	...	2	13
Fraternal Organizations	135	62	114	61	10	63	111	73
Visit Friends and Relatives	125	57	107	57	8	50	10	68

most part the movies are available to the Negroes as well as to the whites. The rather marked differential in attendance might be accounted for partially on the basis of individual preference but probably more largely on the basis of the lower incomes among the Negroes, coupled with transportation factors which render the movies less accessible to them than to the whites.

Attendance is proportionately greater among the tenants than among the other tenure groups. Among the whites, more croppers than resident laborers attend, whereas the opposite obtains among the Negroes.

In general, formal entertainments were attended relatively infrequently, only 16 per cent of the families reporting attendance by their members. As between the races, 25 per cent of the whites as compared with 12 per cent of the colored reported such activity. Little variation existed between the tenure groups of the races, with the exception of the colored croppers, who reported no attendance at entertainments.

As to socials, 19 per cent of the whites and 6 per cent of the Negroes reported such attendance. Tenure differences were relatively small.

Dances as a form of amusement occupied a relatively small place, less than a third of the whites and only 3 per cent of the Negroes reporting such attendance. As to the resident laborers, only 1 per cent reported attendance at dances. The commercial aspect of these affairs doubtless tends to keep down the attendance among the laborers. The conventional types of public dances are either script dances, in which an orchestra is hired and couples charged a fee for entrance, or the more informal type of nickelodeon dance in which the phonograph furnishes music when nickels are dropped into the slot. These dances are held in the commercial recreational halls, which are scattered throughout the area.

Although not usually regarded as a social function, the frequent trips to the nearby villages on Saturdays and other trading days doubtless fill a large gap in the social life of the resident laborer. Six out of ten of the families reported making such trips weekly, but less than one out of ten went more frequently than once per week. On the other hand, two out of ten reported going to the village only once per month, and a few (4.5 per cent) reported going only once or twice per year. Of these latter, nearly all were colored. Although the ostensible purpose of going to town is to make necessary purchases, actually most of the day is spent talking with neighbors and friends and playing games. That the workers regard this type of visiting as filling a real need is evidenced by the illustration given by one employer who has tried without success to persuade his laborers to avail themselves of the considerable saving by buying coal oil in five-gallon lots. Apparently the laborers regarded the excuse for more frequent trips to town as more than sufficient compensation for the higher prices paid for their piece-meal purchases.

Young People's Organizations

Scarcely any organized activity for the young people was found outside of the church. Roughly one-fourth of the families reported children belonging to church organizations. There was little variation between whites and colored. Only five families reported children belonging to some organization in addition to the church. Of these, one was a school organization, one a 4-H Club, and the other three unclassified. Out of the total 328 families, 247, or approximately three out of four, had no children belonging to organizations.

SUMMARY STATEMENTS

1. More than eight out of ten of the 1,000 families (exclusive of owners and special workers) living on the farms studied, had the tenure status of resident laborers. Of these, more than three-fourths were colored.
2. More than one out of four of the families spoke French exclusively, and an additional one out of five spoke French and English. Among the white families, six out of ten spoke French almost exclusively as compared with one out of ten among the Negroes.
3. Ninety-six per cent of the heads of families were born in Louisiana, the remainder coming from relatively nearby.
4. Heads of resident laborer families show an excess of those in the younger age groups as compared with Louisiana as a whole.
5. Resident laborer families were slightly smaller than either the cropper or tenant families. Negro households averaged 4.4 persons, which is approximately one person smaller than the average white household.
6. Nearly one-half of the male family heads of tenants, croppers and laborers had received no formal education. Of all of the families, five received daily papers and two weekly papers.
7. The employment of resident laborers was confined almost entirely to the farms upon which they lived, only three out of 242 having reported work elsewhere.
8. Though the jobs done by resident laborers were quite varied, they were concentrated largely in the harvest and the planting and growing seasons.
9. Two hundred and five of the 242 laborers reported work during the planting and growing season at an average wage of 96 cents per day. The average daily earnings for cutting cane was $1.37.
10. Roughly three-fourths of the resident laborer families reported a gross cash income for the past year, including the contributions of wives and children, of from $250 to $500. White families had slightly larger incomes than Negroes, though Negro family members contributed more than white family members.
11. Eighty-one of the resident laborer families had children of from 10 to 15 years of age. Of these children roughly one-half contributed to the family budget, with an average contribution of $78. White and colored boys contributed with approximately the same relative frequency but the colored boys contributed greater amounts. All of the girl contributors were colored.
12. Paydays were customarily two weeks apart, and 90 per cent of the payment was made in cash. Of those who received cash payment, six out of ten lived on farms maintaining commissaries.

13. Nearly three-fourths of the laborers had chickens. A fourth had cows and pigs, usually only one each.

14. The growing of livestock and garden products by resident laborers and tenants was done almost entirely for home consumption. Only two of the 242 resident laborers reported having sold any products in the market.

15. Resident laborers moved rather infrequently, the average length of residence on the present farm being 13 years and the average number of farms lived on since working for themselves as apart from their parents being 2.5.

16. The average colored resident laborer had lived 14 years on the present farm as compared with 9 years for the whites.

17. The resident laborer belongs to a relatively fixed tenure class. Of 280 heads of families who started out as laborers, nearly eight out of ten still remained laborers.

18. Although roughly one out of ten of the resident laborers stated that he would like to attain the status of ownership, only one out of fifty thought he would ever do so.

19. Eight out of every ten resident laborers received as perquisites a house, garden space, wood and a team for hauling the wood.

20. Nine out of ten of the resident laborers, croppers and tenants received credit advances. Of these, slightly over one-half received the credit from their landlord, a fourth from a merchant, and a small number from both landlord and merchant. The conventional length of advance was between the two-week pay periods.

21. Of the 211 resident laborers receiving advances, 203, or 96 per cent, received them through store orders. Ten per cent of the laborers stated that they were indebted for old advances, the average amount of which was $7.50.

22. Approximately six out of ten of the laborers reported dependence on their landlords in case of emergency. Landlords also reported that they felt this responsibility. Though the families appear to be in need of this immediate protection, the desirability of fostering such dependence is open to serious question as a long-run policy.

23. Seven out of ten of the tenants and croppers had glass windows in their houses, as compared with three out of ten for the resident laborers.

24. Two out of ten of all houses had some screening. Among the colored houses, less than one out of ten had screening.

25. The most commonly found laborer house consisted of two rooms with three-, four-, and five-room houses next in order of frequency. Share cropper and tenant houses averaged larger than laborer houses.

26. Over one-third of the laborer households possessed sewing machines. The proportion was greater for whites than for colored.
27. Fourteen per cent of the households reported ice boxes and phonographs, five per cent radios, four per cent electricity, and smaller percentages running water, bath tubs, telephone, and daily and weekly papers.
28. Church attendance was by far the most important formal community activity, more than nine out of ten of the tenants, croppers and laborers stating that members of their families participated.
29. More than six out of ten of all families had members belonging to lodges. Less than two out of ten had members who conventionally went to picture shows. Less than a third of the white and only three per cent of the colored laborers reported attending dances.
30. Five of the 328 families reported participation by their children in organizations outside the church.

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New Settlement Problems in the Northeastern Louisiana Delta

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APPROVED FOR PUBLICATION BY C. T. DOWELL,
MAY, 1941

LOUISIANA AGRICULTURAL EXPERIMENT STATION
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LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS

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FOREWORD

Among the most pressing problems in several sections of the United States are those associated with the current settlement of land for farming purposes. Throughout the Delta of the lower Mississippi Alluvial Valley, in the regions surrounding Lake Okeechobee in Florida, in the Basin of the Columbia River, and to a limited extent in the Cumberland Plateau are to be found thousands of families seeking to establish permanent farm homes. Although their efforts are in a sense "pioneering," actually they are beset with economic and social maladjustments far more difficult of solution than the relatively simple physical problems and hazards ordinarily associated with a pioneer agriculture.

The desirability of this new settlement and the causes for such a movement are, of course, debatable topics. Some may view the opening of new agricultural lands as a factor further complicating the "farm problem," particularly when it is considered one of over-production of basic agricultural commodities, and hence they would not encourage such a movement. Others will see in the development a very desirable shift of production from poor to good agricultural lands. As to the cause of the settlement some will see it as a natural result of production and price controls, while others will see it as a manifestation of the pressure of surplus farm people on the land resources of the Nation. Regardless of the differences of opinion on these questions, most economists and sociologists recognize the need for protecting the settler against dubious land selling schemes, high land prices, high interest rates, and difficult purchase terms, so as to prevent undue hardship and suffering among farm families attempting to establish homes for themselves.

This study was undertaken as an investigation of new settlement in an area typical of the problems encountered throughout the lower Mississippi River Alluvial Valley. From it have come suggestions for needed programs of action representing major modifications of existing policies or the institution of totally new programs. These recommendations have been developed in constant consultation with the representatives of State and Federal agricultural agencies, with farm leaders, and with members of parish and State agricultural planning committees. The success of any program in the area will, therefore, depend largely on the extent to which such action is carried out in continued cooperation with the farm people most directly concerned and with others most likely to know wherein changes and modifications will bring about a desirable pattern of land utilization.

R. J. Saville represented the Louisiana Agricultural Experiment Station as project leader for this study and Dean W. Blackburn served in a similar capacity for the Bureau of Agricultural Economics. The authors are indebted to B. M. Gile, Professor of Agricultural Economics, Louisiana State University, James H. Marshall, BAE Representative for Louisiana, and C. A. Rose, Parish Agricultural Agent, East Carroll Parish, for their interest and guidance during the entire time the study was in progress. Other assistance is appropriately acknowledged in footnotes throughout the text.

This study was completed and a few mimeographed copies reproduced in July, 1940. Part II of the mimeographed edition contains considerable statistical data, maps, and photographs not reproduced in this bulletin, but which are available for reference purposes in the libraries of the Louisiana State University and the Bureau of Agricultural Economics.

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NEW SETTLEMENT PROBLEMS IN THE NORTHEASTERN LOUISIANA DELTA

By Phillip E. Jones, *Instructor,* Louisiana State University, and John E. Mason and Joseph T. Elvove, *Associate Agricultural Economists,* Bureau of Agricultural Economics, U. S. Department of Agriculture.

INTRODUCTION

Thousands of acres of fertile, cutover, poorly drained lands in the alluvial areas of northeastern Louisiana are being settled and developed for farming purposes by low income farmers from the hills of Arkansas, Louisiana, and Mississippi and by sharecroppers and tenants from nearby plantations. These pioneers are carving out their homes in a wilderness very similar to that which challenged their forefathers, but the present settlers are faced with additional social and economic difficulties which the rest of the Nation has struggled with during the depression. The frontiers may be gone, but certain termendously valuable areas in the alluvial valley of the lower Mississippi River remain to be opened and fully developed for the use of man.

The purpose of the Northeastern Louisiana Delta study is to appraise past settlement and agricultural development in an area where new settlement is proceeding at a relatively rapid rate, and to determine the physical and economic feasibility of further development as a basis for recommending desirable public policy relating to such settlement and development. The procedure involves: (1) considering the physical and economic feasibility of draining the undeveloped lands; (2) considering the hazards, the necessary outlays, and the amount of capital required or advisable to insure reasonable chances of success from the standpoint of the farm family contemplating purchase and settlement on unimproved land; (3) comparing the market price of unimproved land plus the probable costs of development with the price of similar grades of improved land; (4) analyzing the data obtained directly from the new farmers on lease or purchase arrangements, difficulties encountered under the contract, progress in clearing and developing the land, cost of clearing the land and erecting the house, barn, fences, and other improvements, source and amount of credit, tenure history, and several factors indicating the level of living; (5) estimating the past and prospective future costs for public facilities and services incident to settlement and development; (6) considering the legal aspects involved in the leasing and purchasing arrangements; and (7) considering measures which would be useful in the sound development of the land resources in the Delta.

This report describes the cutover areas of the Northeastern Louisiana Delta from a physical and historical standpoint, discusses the principal economic and social problems encountered by the new settlers, and offers recommendations of policy for the consideration of local, State, and Federal governmental agencies, private land development promoters, as well as prospective purchasers.

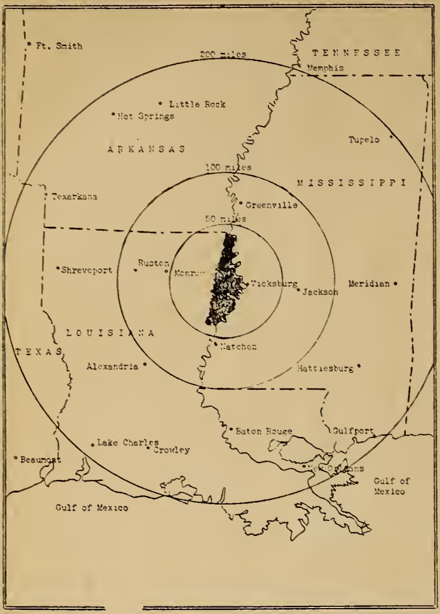

Figure 1.—Location of East Carroll, Madison, and Tensas Parishes, Louisiana.

The location of the three Delta parishes selected as representative of the problems is shown in Figure 1, which also indicates the setting with regard to several large urban centers.

HISTORICAL AND PHYSICAL SETTING

Although the first annual report (1917) of the Louisiana Tax Commission (then Board of State Affairs) classifies nearly one-half (458,753 acres) of the area as land having a merchantable stand of hardwood timber, today only 132,945 acres remain (Table 1). No attempt is being made at reforestation, and the lumber companies are no longer interested in retaining land that has ceased to yield an income; consequently, they are disposing of these cutover lands as rapidly as possible. During the past ten years approximately 1,500 families have entered the strip of undeveloped land which extends for a distance of about 100 miles south from the Arkansas-Louisiana line across East Carroll, Madison, and Tensas parishes. The new settlers have cleared approximately 37,500 of the 67,500 acres they are trying to develop. More than 300,000 acres of fertile land in East Carroll, Madison, and Tensas parishes can be economically drained and developed for settlement.

TABLE 1.—LAND IN HARDWOOD TIMBER, EAST CARROLL, MADISON AND TENSAS PARISHES, 1917-1939[1]

YEAR	East Carroll	Madison	Tensas	TOTAL
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*
1917	57	221	181	459
1918	61	204	196	461
1919	63	198	175	436
1920	64	202	147	412
1921	52	191	140	383
1922	48	178	128	354
1923	45	184	97	326
1924	41	172	85	298
1925	32	162	82	276
1926	21	153	58	233
1927	21	148	106	276
1928	22	141	100	263
1929	21	124	61	206
1930	21	121	73	215
1931	19	117	72	208
1932	19	117	60	196
1933	20	120	81	221
1934	14	115	80	209
1935	3	113	78	194
1936	1	113	54	168
1937	2	96	50	148
1938	*	95	49	144
1939	*	86	47	133

[1] Annual reports of the Louisiana Tax Commission.
* Less than 500 acres.

Although Indians and a few Spanish settlers had cleared some of the high lands of the Delta prior to 1820, it was not until about this date or shortly therafter that more permanent settlers arrived, largely from Kentucky and Tennessee, and the states farther east. About 1840, settlers began to arrive in larger numbers, and for a period of 20 years agriculture apparently prospered.[1] According to the authors of the soil survey report of 1909,[2] agricultural development between 1856 and the date of the survey had been slow owing to occasional almost complete crop failures, overflows, trouble in securing satisfactory labor and new settlers, one-crop farming system, and lack of proper drainage.

It has been generally reported, and evidence such as old graveyards, brick cisterns, ruins of antebellum plantation houses overgrown with second-growth timber, and slave levees supports the contention, that some of the area now being cleared was farmed prior to the Civil War. Following the war and the liberation of the slaves, many of whom went north and to other sections of the country, thousands of acres of rich plantation lands were abandoned and the land returned to forest growth. When the railroads were built, there was some shift of cotton production from along the bayou banks to the vicinity of the railroads, which were generally constructed on the "front lands" of the Mississippi River. Shortly after 1900, in one way or another, large tracts of the abandoned lands as well as virgin timber lands fell into the possession of lumber companies who kept it for a long period solely for the timber. The advertising literature of one company states that: "The land was purchased . . . for its timber. We are not in the land business, and now that the timber has been removed, we are practically letting you 'name your own terms' in order to have this property settled by good farmers."

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[1] Worthen, E. L., and Belden, H. L., Soil Survey of East Carroll and West Carroll Parishes, Louisiana. Bureau of Soils, U. S. Department of Agriculture, 1909, p. 9.
[2] *Ibid.*

It so happened that the lumber companies completed their lumbering activities on much of this land at about the beginning of the depression of the early thirties and started at once disposing of it. This coincided with a movement of people forced by drought and the depression from their homes in the hills of Louisiana, Arkansas, and Mississippi. Some of the hill people came into the Delta to pick cotton, found yields two or three times as great as in the hills, decided to stay, and reported the possibilities to their relatives and friends back home. Beginning about 1930, speeding up somewhat in 1932, and then reaching a climax in 1937 and 1938 (Figure 2), farm development has taken place in the cutover lands in the western part of East Carroll, Madison, and Tensas parishes (and in other parishes in the Delta not under consideration here). A total of 266 new applications for cotton acreage allotments for 1940 were filed in these three parishes.

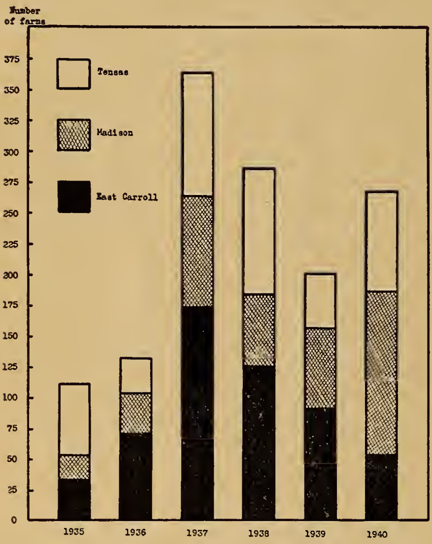

FIGURE 2.—NUMBER OF NEW FARMS IN EAST CARROLL, MADISON, AND TENSAS PARISHES, LOUISIANA, BY YEARS, 1935-1940.

Three-fourths of the 53,242 inhabitants of the three-parish area were classified by the Census of 1940 as rural farm. Although only 25 per cent of the rural farm population in 1930 was white, new settlement during the past decade has increased the proportion of white families noticeably. The colored rural families at present are mainly sharecroppers on cotton plantations, although in the recent settlement that has occurred in the area three or four communities of colored families have made an effort to buy and pay for small acreages to be used for farming purposes. It is estimated that three-fourths of the new settlers are white and that the remainder are colored.

Generally, each race is forming definite communities, but in a few places the two races are selecting their homes indiscriminately, without regard to color. The problem of settlement by races is taken care of to some extent by the vendors of land when they decide to sell certain blocks to whites and certain other blocks to negroes. Largely because the negroes are more willing to accept the less desirable locations, their settlements are usually on the most inaccessible, poorly drained lands that have been brought into farms, despite the fact that they pay just as much for their land as do the white people who are given the more favorable locations. According to an agent for one company, good white farmers would not have purchased the inaccessible, poorly drained lands at the prices the negroes paid. This development may create difficulties in the provision of efficient and economic schools, especially in cases where 5 or 6 negro families are grouped together several miles from an existing school for their race.

Topography and Drainage Potentialities

The three parishes contain 1,702 square miles of flat, alluvial lands intersected by numerous swamps, lakes, and bayous. Tensas River and Bayou Macon, old overflow channels of the Mississippi River, together with a network of small bayous, form the natural drains for the area. The water from Bayou Macon and Tensas River finally finds its way to the Mississippi River through the Black and the Red rivers. During flood times much alluvium from the soil-laden waters settled near the streams, while a lesser amount was deposited farther back, thereby creating low ridges or front lands 2 to 12 feet higher than the surrounding land; therefore, surface waters now flow away from the streams and collect in basin-like areas some distance from the bayous. Because of higher elevation and lighter soil texture the best drained lands are generally the narrow strips along the bayou banks. Many of the narrow strips average approximately one-fourth mile in width and have an elevation above sea level of from 85 to 90 feet, while the basin-like areas one-half mile or more from the bayous have an elevation of only 75 to 80 feet in their lowest places.

Inadequate drainage is the limiting physical factor in the development of this large area of cutover fertile land. The county agents of the three parishes studied assert that poor drainage is one of their major problems. Fully one-half of the potential agricultural land in the three-parish area is insufficiently drained at present to allow successful agricultural development, and practically all of the remainder would be greatly improved by better drainage. The water table is found within a few feet of the surface during much of the year, and in many areas it is practically at the surface throughout the winter and spring months. At the time of the field enumeration for this study the farmers pointed out parts of fields, entire fields, and in some cases nearly complete farm units on which water stands for weeks or even months in the winter and spring. This standing water is usually the result of ordinary rainfall, but in some instances, it is due to local bayou overflows.

Records obtained from 100 new-ground farmers in East Carroll Parish show that less than one-half of the cleared land is adequately drained for crops, that 55 per cent needs drainage, and that 23 per cent floods seasonally from local streams; yet none of this is impractical to drain (Table 2). Settlers report both surface drainage and outlet problems, and only one-third of them think they could drain their lands independently. About all that an individual can do in the way of drainage is to plow water furrows through the fields. This is a difficult problem because of stumps. When the water reaches the woods, the individual cannot construct a ditch, since he has no facilities for such work, and he does not own the land all of the way to the main drainage channel. Approximately two-thirds of the settlers complain of water from some other person's land draining upon theirs. Largely due to the fact that they buy the more poorly drained land, the negroes have a higher proportion of land which needs draining.

TABLE 2.—PRESENT DRAINAGE CONDITIONS ON NEW LAND FARMS, BY RACE OF OPERATOR, NORTHEASTERN LOUISIANA DELTA, 1939[1]

DRAINAGE CONDITION	SETTLER GROUPS BY RACE					
	WHITE SETTLERS		COLORED SETTLERS		ALL SETTLERS	
	Acres	Per cent	Acres	Per cent	Acres	Per cent
Adequately drained						
Cleared	742	48.7	270	33.3	1,012	43.4
Uncleared	351	33.3	239	31.7	590	32.6
Drainage should be improved						
Cleared	764	50.1	531	65.5	1,295	55.4
Uncleared	686	65.0	514	68.3	1,200	66.4
Impractical to drain						
Cleared	0	0	0	0	0	0
Uncleared	14	1.3	0	0	14	.2
Floods seasonally						
Cleared	208	13.6	335	41.3	543	23.2
Uncleared	258	24.5	385	51.1	643	35.6

[1] Data in all tables not otherwise identified were obtained from 100 new-ground farmers in East Carroll Parish.

At present there are five drainage districts in East Carroll Parish and two in Tensas Parish, covering a total of approximately 180,000 acres, or 16.5 per cent of the land area. Some of these districts are in or extend into the areas now being settled; nevertheless, the new settlers are apparently receiving little benefit, if any, from existing drainage works. One main reason for this seems to be that the new settlers have little or no capital or equipment and, consequently, cannot get adequate lateral ditches through the woods to canals or streams.

The authors of the soil survey[3] of East Carroll and West Carroll parishes wrote in 1909:

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[3] Worthen, E. L., and Belden, H. L., *op. cit.*, p. 4.

> The thorough drainage of the extensive areas of so-called "swamp," which includes practically all of the Sharkey Clay . . . would require too large an outlay to be met by private means, and such a project will very likely have to be carried out by some corporation or through government aid. There are numerous natural drainage ways to be found throughout these low areas, but they must be broadened and deepened, and in some cases straightened, before they will be able to carry water from the area through which they will flow.

The area, although not subject to backwater hazards, has been subject to floods from overflow since the beginning of recorded history. Because the levees were allowed to fall into disrepair during the Civil War period, the floods of 1862 and 1865 did great damage to the levee system. Economic prostration precluded effective repair by local interests, and no appropriations were made for levee construction by the Federal government.[4] The Civil War liberated the negroes; this in turn resulted in the abandonment of the lowlands. In the following years floods occurred often enough to prevent settlement of the area. The flood in the spring of 1927 almost caused the failure of a land development company composed of northern white people attempting to open about 5,000 acres of cutover land in East Carroll Parish; it so discouraged them that a large majority left the colony in that, their second year, never to return.

The area was first protected against Mississippi River overflow by locally constructed levees. More protective levees were built by groups of landowners from time to time with some Federal aid, but finally in 1928 Congress authorized the completion of a comprehensive plan by the Federal government. The disastrous overflows of the Mississippi River have now been reduced or possibly eliminated through the enlargement of the Mississippi River levee system and the development of several cutoffs; however, before settlement of the area can take place under the most favorable conditions, the land must be drained.

The special drainage survey made as a part of this study indicates that approximately 90 per cent of the area can be successfully drained at a reasonable cost.[5] This survey was necessarily too generalized to map the specific areas which cannot be drained, owing to the fact that such areas exist as small "pockets" scattered throughout the three parishes. Primary and secondary drainage for 80 per cent of the undeveloped lands can be provided at a cost of $7 to $8 per acre (Table 3). An additional 10 per cent can be profitably drained but at somewhat higher cost.

The Tensas River is the natural drainage channel for the area; therefore, the water surface elevation of this stream at the different places of inflow is the elevation that governs the drainage possibilities of the natural tributaries or of ditches that may be excavated. Actual gage records

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[4] Elliot, D. O. *The Improvement of the Lower Mississippi River for Flood Control and Navigation,* Vol. 1, p. 11, U. S. Waterways Experiment Station, War Department, Vicksburg, May, 1932.

[5] The information in the following paragraphs is based upon the special drainage survey made by L. R. Parmelee, Civil Engineer, cooperatively employed by the Louisiana Agricultural Experiment Station and Bureau of Agricultural Economics. Most of the technical phases of the report are omitted from this bulletin.

TABLE 3.—ESTIMATED COST PER ACRE OF A DRAINAGE SYSTEM FOR EAST CARROLL, MADISON, AND TENSAS PARISHES, LOUISIANA[1]

ITEM	East Carroll	Madison	Tensas
	Dollars	*Dollars*	*Dollars*
Primary channels			
Construction	2.23	2.13	2.60
Administration	.22	.22	.27
Financing (25-year, 4 per cent bonds)	1.47	1.41	1.72
Secondary ditches			
Construction, administration, and financing	2.40	2.40	2.40
Rights-of-way and contingencies	.63	.62	.70
TOTAL	6.95	6.78	7.69
Annual cost per acre for construction, administration, financing, and contingencies	.28	.27	.31
Annual maintenance	.10	.10	.10

[1] These data are from the special drainage survey referred to in the text and are based upon the asumption that a unified system is to be constructed, covering East Carroll, Madison, and Tensas parishes.

on the Tensas River are limited to one gaging station and to a period of four years. This information, together with other data supplied by the U. S. Engineers and the Louisiana Board of State Engineers, indicates that the Tensas River is an adequate channel for draining the area. It can be conservatively stated that retarded flow in the branch channels by reason of excess water in the Tensas River will occur not oftener than once in five years, and this would be only in the southern part of Tensas Parish.

To improve the carrying capacity of Tensas River the following work will be required: (1) clear the channel of all growth, drift, and debris within the flow section; (2) excavate cut-offs which would increase slopes, thereby velocities, and consequently discharge at lower stages; and (3) dredge the channel, giving proper consideration to the section in respect to the hydraulic radius. It is estimated that the carrying capacity of the Tensas River can be increased from 15 to 25 per cent by clearing the channel and bank of trees, bushes, debris, and other impediments to flow, and by the removal of bars. The existing system in East Carroll Parish will be greatly benefitted by clearing and re-excavating Tensas Bayou at least as far south as the north boundary of Madison Parish. Clearing the channel in Madison and Tensas parishes is also advisable. The calculations to determine the cost of adequate drainage provide for this work on the Tensas.

Data assembled for the drainage report indicate that the total cost of constructing, administering, and financing of primary and secondary drainage will amount to $484,849, or $6.95 per acre, in East Carroll Parish, $762,542, or $6.78 per acre, in Madison Parish and $869,827, or $7.69 per acre, in Tensas Parish for the areas requiring drainage. The total annual cost per acre for the life of 25-year bonds will be 27.8 cents in East Carroll, 27.1 cents in Madison, and 30.8 cents in Tensas; however, in the case of a bond issue, the base of the assessments would necessarily be slightly higher than these figures in order to make up for delinquencies.

The cost of clearing the Tensas River in Madison and Tensas parishes is prorated to these parishes on the basis of their respective acreages, and East Carroll Parish is charged with clearing and excavating Tensas Bayou as far south as the north boundary of Madison Parish.

The drainage cost figures given above do not include the cost of farm drainage, which is estimated to range from one to two dollars per acre, depending upon the individual farmer and local conditions. The figures do include, however, the cost of secondary ditches. The primary system is designed so that a minimum number of secondary ditches will border or cross every section of land.

Inasmuch as the Tensas River will be the backbone of any drainage enterprise that may be inaugurated, the most logical organization would include the three parishes as a unit. By such an organization, an integrated and unified plan could be developed, assessments could be better equalized, administration costs would be lower, and maintenance of the system could be handled much more efficiently. The cost data in this report have been calculated on the assumption that any drainage enterprise will be organized for the area as a whole.

Soils

A soil survey was made of East Carroll and West Carroll parishes in 1908, and in 1936 a generalized soil survey was made of the area for the proposed Eudora Floodway, the section where much new settlement has taken place since 1930.

The soils of the area are entirely of alluvial origin, and include the following important types: Sharkey clay, Wabash clay, Tensas clay, Yazoo loam, and Yazoo fine sandy loam. The coarser soils are distributed along the rivers and streams, while the finer soils are found in the lower areas away from the streams. The general soils condition may be described as follows:

> The natural levees bordering the bayous have the higher elevations and usually have lighter textured surfaces. The heavy textures predominate in the shallow basins formed by the natural levees along the bayous. There is a gradual increase in the proportions of the lighter colored and more poorly drained areas from north to south and a correlative decrease in elevation, organic content, and increased acidity. The natural levees along the bayous become less pronounced, narrower, heavier textured, and the basins become grayer in color, heavier textured, and more poorly drained from north to south.[6]

Although the soil is not all of a uniformly high quality, there seems to be no question concerning the fertility of the soil upon which most of the new settlers are locating. With reference to the soil in the undeveloped areas in East Carroll Parish, the soil surveyors point out that:

> This is a very fertile soil and with proper drainage and absolute protection from inundation it could be made to produce good yields of cotton, corn and rice.[7]

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[6] Browning, James W. *Factors Affecting Land Values, Eudora Floodway, Louisiana Portion,* U. S. Department of Agriculture, June 1937. Unpublished. p. 17.

[7] Worthen, E. L., and Belden, H. L., *op cit.,* p. 20.

Cotton yields on newly cleared lands in the Delta are generally lower than on similar lands which have been in cultivation for a few years. Data obtained from 100 new-ground farmers in East Carroll Parish reveal an average cotton yield per acre for the first year of 340 pounds, 365 pounds the second year, and 405 pounds the third year. In Madison Parish, 46 new-ground farmers had an average cotton yield of 276 pounds per acre in 1938, the initial year on their farms, but in 1939 the yield for 43 of the group still farming had risen to an average of 524 pounds per acre. In 1939, 75 farmers in Madison Parish planting cotton for the first time on newly opened land made an average yield of 307 pounds per acre.[8] After a period of 6 or 8 years, cotton yields on these soils may be expected to decline unless the land is carefully managed and planted frequently to cover crops. Continued use without special cropping practices depletes the supply of available nitrogen and increases the unsatisfactory moisture conditions and difficulty of cultivation. Absorption of water and internal drainage on the heavy textured soils are slow, and wet conditions during the early part of the growing season limit cotton and alfalfa yields, whereas dry conditions later on affect corn adversely. New settlers are usually not aware of these problems because unsatisfactory soil and moisture relationship on the heavy-textured soils are less noticeable in the virgin areas than on soils which have been cultivated for a few years. The heavy-textured soils must be planted to legumes regularly and plowed deeply to prevent crop yields from going so low as to be unprofitable. This fact needs particular emphasis, and prospective settlers should be informed of the management difficulties they will encounter after the virgin qualities of the soils are lost.

OWNERSHIP AND MANNER OF LAND ACQUISITION BY NEW SETTLERS

Type of Ownership

Title to the undeveloped cutover lands in the Delta is largely in the hands of nonresident owners (Table 4). Approximately one-third of the total area of the three parishes is owned by nonresident corporations and an additional one-fourth is owned by individuals whose residence is outside of the parish in which the land is located. Some of the undeveloped lands are owned by residents of the area, but most of the resident holdings consist of farm lands being operated as plantations. The Federal government owns a few tracts of land in the Delta, developed by the Farm Security Administration into resettlement projects. The Farm Security Administration purchased large plantations that were already in cultivation and thus far has not bought undeveloped lands. In East Carroll Parish, the parish school board controls a few sections of land, but aside from these small areas and the projects of the Farm Security Administration publicly-owned lands are insignificant.

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[8] Madison Parish data from A.A.A. records.

TABLE 4.—TYPE OF LAND OWNERSHIP IN THE NORTHEASTERN LOUISIANA DELTA [1]

TYPE OF OWNERSHIP	TOTAL	East Carroll	Madison	Tensas
	Per cent	*Per cent*	*Per cent*	*Per cent*
Corporation				
Resident in parish	4.9	1.3	4.6	7.5
Nonresident	35.6	20.4	50.3	31.4
Individual				
Resident in parish	32.8	45.4	25.1	32.5
Nonresident	23.0	23.1	17.5	28.5
State and parish	1.1	2.6	.2	.1
Federal	2.6	7.2	2.3	0

[1] Planimetered from originals of type of ownership maps on file at the Louisiana Agricultural Experiment Station.

Contractual Arrangements

Lumber companies and others owning large tracts of cutover land are disposing of their holdings at prices ranging from $10 to $75 per acre; however, most of the land is being sold at from $25 to $40 per acre. The prospective purchasers, consisting largely of whites from the hills and negroes from the Delta of Louisiana, Mississippi, and Arkansas, are leasing with an option to purchase or contracting to purchase small units for farm home purposes. Land is being brought into cultivation under at least three different arrangements. The first one listed below is by far the most extensive and most important, since more than two-thirds of the new settlement in the three Delta parishes under consideration in this report is taking place under this arrangement (Table 5). The principal arrangements are:

1. Lease or rent contracts with option to purchase family-sized units, or purchase contracts with a down payment provision.
2. Expansion of plantations by using wage hands to clear the land or by clearing with heavy machinery.
3. Development of entirely new plantations by hiring the land cleared for cash, by giving all the crops for two or three years as compensation for clearing, or by some other rental arrangement.

New settlers in the Delta acquiring land under a lease or rent contract with an option to purchase usually make three crops before starting payments. Those entering into purchase contract arrangements make a down payment of about 10 per cent with another payment due at the end of the first year. The most liberal payment plan allows the "free use" during the lease or option period of 3 years with an additional 10 years in which to pay for the land in annual installments. Emphasis should be given to the fact that the settlers believe they can establish homes in this area without a large outlay of cash—a hope which is often not realized. Even though a settler may find making payments as agreed upon impossible and may thus subject himself to repossession after the option period has elapsed, he is willing to devote long hours to hard labor in order that he might have a home for at least the years of the option. Since much of the land is being bought not on the basis of expected farm income but partly in satisfaction of a land hunger, the settlers frequently contract to pay more than the economic returns will justify. Many of the farmers entering into option-lease agreements do not fully realize at the time of making the contract that virtually unbearable payments of principal plus interest and taxes will start at the end of the third year, and it is not until about the second year that this becomes evident to any large number of them.

The contracts of the various land selling agencies differ in detail, but the following items appear in the lease or purchase contracts:

1. Legal description of property.
2. Stipulated price for the land in the event the purchase option is exercised; also including terms for payment and interest rate.
3. Agreement by the lessee (or purchaser) to pay interest, taxes, insurance and any expenditure which the lessor (or vendor) may incur in improving the property.
4. Agreement by the lessee (or purchaser) to clear a stipulated acreage each year.
5. Retention of all or part of the mineral rights by the lessor (or vendor).
6. Cancellation clause should any of the provisions be violated by the lessee (or purchaser).
7. Agreement by the lessee (or purchaser) to erect buildings and other improvements which shall, without charge, become the property of the lessor (or vendor) at the termination of the lessee's (or purchaser's) possession.

One contract contains the following statement relative to the erection of buildings and other improvements:

> All of which buildings and improvements shall, immediately upon erection thereof, belong to and become the property of said lessor corporation, which last mentioned condition is declared to be one of the chief causes for the execution of this contract on the part of said lessor corporation. . . .

The following paragraphs from another contract deal with cancellation of the agreement:

> Time being of the essence of this contract, it is especially agreed and understood that if any of said rent notes, and the sums to be paid as rent, be not promptly paid at maturity, or if the taxes due for any one of the years above mentioned be not promptly paid, together with all insurance premiums as above, and any and all sums provided for as rent as above, or if any timber is cut save for the use of the plantation, or if any promise or covenant entered into herein is violated in any particular, then this lease, including the option to purchase hereinafter mentioned shall, without notice terminate and cease, and the lessor and his agents shall be entitled to immediate possession of the leased property, and said

> lessee shall not be entitled to any credit on this amount by reason of any sums which the lessor may collect as rent from others for future years.
>
> It is further agreed that if default be made in any of the covenants herein contained, said default or failure upon the part of the lessee is to be considered as a waiver of notice to vacate the premises, as provided by the laws of the State of Louisiana; and the lessee in such event, obligates himself to deliver up and return the said premises and appurtenances unto the lessor in as good order as they had been received by the lessee the usual wear and tear excepted.
>
> As a further consideration for the granting of this lease and option, it is hereby agreed that all repairs, additions, and improvements of whatever nature made by the lessee on the land herein described shall, without charge, become the property of the lessor at the termination of the lessee's possession, in whatever manner the same may be brought`about.

Although the contracts often contain the specific provisions indicated above, they are not always strictly adhered to by the lessor (or vendor). In a letter enclosing a statement of the amount due from a settler, one important lumber company lists four things which are taken into consideration in determining whether or not the purchaser is fulfilling his contract, namely, (1) number of acres cleared and placed in cultivation and other improvements made on the property; (2) payments made on the land; (3) farming program followed by the purchaser; and (4) general attitude toward the company, neighbors, and the community.

Some variation exists in the time stipulated in which the new settlers receive deeds. In many cases a deed may be obtained upon exercise of the purchase option and payment of the first note, provided interest, taxes, and other costs have also been paid. Recording of the deed is important because until this is done settlers are not eligible for homestead exemption. Although in some cases the land may still be assessed to the vendor after the option period is over, the amount of the taxes is added to the vendee's note. One company deeds the property upon receipt of the first payment, which it has arbitrarily set at $100, regardless of the size of the farm, although the succeeding payments are usually more than this amount. In some instances the instrument is given when one-tenth of the total amount originally due has been paid, while in others it is executed when one-half of all sums due have been paid. In a few cases the deed is withheld until all payments have been made.

Some contracts, usually called "rent contracts," provide that one-fourth of the cotton shall be sold and the proceeds applied to the purchase price of the land in lieu of the agreed upon annual installment. Such flexibility in the amount of payments is a desirable feature of this type of contract.

Some companies advance lumber for buildings and receive payment, including interest, for such materials in the same manner as they receive payment for the land. At least one company sells rough, third-grade lumber to settlers at prices commensurate with high-quality material. White farmers are furnished with lumber less often than are negroes.

Nature of Land Titles[9]

One contract provides that the seller will execute a deed to the buyer "which deed will be of standard Louisiana form," but no mention is made of the nature of the title that will be conveyed to the buyer. The seller does not warrant that he is the owner of the property and able to convey clear title, except that the contract recites that "the ownership and title to this land is fully vested" in the seller "during the life of this contract" and the buyer "acquires neither ownership nor title to this land by reason of this contract." That could possibly be construed as a representation to the buyer that the seller owns the land free and clear of encumbrances, but it was probably not intended as such but rather as a limitation upon the interest of the buyer, pending the execution and delivery of a deed to him by the seller.

Another contract provides that the lessor will execute an "act of sale" to the lessee, in the event that he accepts the option. Furthermore, it specifically provides that the lessor shall not fully warrant the title to the property, but, on the contrary, shall warrant it only against "trouble, eviction, etc., arising from the acts and promises of the vendor." It is also recited that the vendee is "fully aware of the character of the vendor's title and purchases same at his risks and peril." Moreover, the vendee "waives all claim to restitution of the price he has paid in case of trouble or eviction, except such as may be caused by the vendor."

It would, therefore, be desirable in contracts of this kind to recite that the seller has title to the land and that he agrees to convey a fee simple title to the seller, free and clear of encumbrances. Even so, a prudent buyer would not rely solely upon such representations in a contract, for, if it should happen that the seller did not have title to the land and could not comply with his contract after the buyer had met all of his obligations under the contract and had paid the entire purchase price, there would be slight remedy for the buyer if the seller were insolvent or irresponsible. Consequently, a prudent buyer would have the title searched before entering into the contract and making his payments. This indicates the need for a plan to provide legal assistance to new settlers in checking titles to the land they propose to buy, or a plan of title insurance similar to that now used by the Farm Security Administration in its tenant purchase program.

Land Development by Large Operators

A portion of the land is being developed by other than farm families intending to purchase. For example, several plantation operators are adding new land to their farms and using wage hands for clearing operations. At least one large operator is clearing land by mechanical means, while a few owners of cutover tracts are getting their lands cleared by hiring it done for cash, by giving all the crop for two or three years as compensation for clearing, or by some other rental agreement. In such instances, except where the settler is attempting to buy the land, the houses and other improvements are paid for by the landowner rather than by the persons engaged in clearing the land.

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[9] This discussion is based upon a memorandum prepared especially for this study by the Office of the Solicitor, United States Department of Agriculture.

Five large plantations in East Carroll Parish are expanding into the cutover lands, and six small plantations are being developed entirely from new ground. During the past two years the old plantation group has brought into cultivation approximately 1,500 acres of new land; the six new plantations have placed 1,749 acres in cultivation, of which 639 acres are in cotton. Thus, 22 per cent of the 17,000 acres which have been cleared in East Carroll Parish in the past 10 years were brought into cultivation by large operators.

In East Carroll Parish, data from the A.A.A. records show that farmers planting cotton for the first time expect to cultivate 733 acres for their crop in 1940, that those on old plantations expect to clear an additional 749 acres, and that the remaining small farms (those established for more than one year) added about 900 acres to their cleared acreage for 1940. This shows clearly that the small, new-ground farmer is not responsible for all of the reduction in cotton allotment which must necessarily be made on the farms of old producers as new land is brought into cultivation. In this particular year 32.7 per cent of the increase in cultivated land was made by large plantations.

Data supplied by the Agricultural Adjustment Administration for Madison Parish show that for 1938-40, inclusive, 5,310 acres were cleared, of which 1,266 acres, or 23.8 per cent, were brought into cultivation by existing plantations. Entirely new plantations have not been established in the cutover area of Madison Parish, but old plantations have about reached their limit for expansion, and further development will be done by the small operator or by the establishment of new plantations. When old plantation owners clear additional new land, they seldom bring in more families but rather increase the cultivated acreage of each family already on the place.

Tenure Status of New Settlers

Available data indicate that 70 per cent of the families on the new lands in the Delta are attempting to purchase a farm, 18.1 per cent are croppers, 6.5 per cent are renters, and 5.4 per cent are wage hands (Table 5). The croppers and wage hands are located mainly on the new plantations, although a few are to be found on the small new-ground farms. There seems to be a tendency for the purchasers of 40- or 80-acre tracts to bring in a renter or cropper after a year or two. In fact, approximately 1 out of 5 of the purchasers have one or more renters, croppers, or hired men on their farms. In the southwestern part of Madison Parish and in Tensas Parish there are several small tracts of land being operated by tenants whose landlords live in Franklin Parish.

TABLE 5.—TENURE CLASSIFICATION OF NEW SETTLERS IN THE NORTHEASTERN LOUISIANA DELTA, 1939

TENURE GROUP	East Carroll[1]	Madison[2]	Tensas[3]	TOTAL
	Per cent	*Per cent*	*Per cent*	*Per cent*
Owner	67.0	74.4	72.7	70.0
Renter	4.7	8.6	9.1	6.5
Cropper	23.6	11.7	9.1	18.1
Wage hand	4.7	5.3	9.1	5.4
TOTAL	100.0	100.0	100.0	100.0

[1] Tabulated by the authors in collaboration with the parish A. A. A. officials and the parish F. S. A. supervisor.

[2] Tabulated by the authors in collaboration with the county agent.

[3] From unpublished data on file in the Sociology Department, Louisiana State University.

The renters, croppers, and wage hands who do not intend to purchase are not confronted with as many serious problems as the settlers who are attempting to pay for land. They do not have to worry about making enough money to make their annual payments, nor are they concerned about the cost of establishing improvements. Although the problems of this group are serious enough, the major problems relative to directing settlement in the area are those concerning the settler who is attempting to buy land.

Land Prices, Interest, and Amount of Payments

Settlers are attempting to purchase an average tract 44 acres in size and are agreeing to pay for this land at the rate of $27.77 per acre. Whereas the amount of land bought and the price paid per acre of land are practically the same for white and colored farmers, there may be considerable variation in the quality of land sold to the different races.

The amount of land which the settlers are attempting to buy, as well as the price agreed upon per acre, varies with the type of contract into which they enter. When a down payment is made on the purchase price, the contract is termed a "purchase contract"; when no down payment is made and when the settler is given a period of years, usually three, during which he can remain on the farm without making a payment, he is said to have entered into an "option-lease contract." A majority of the contracts are of the option-lease type, but the current trend seems to be toward purchase contracts. White farmers with purchase contracts are attempting to buy 55 acres of land at an average price of $22.33 per acre as compared with 43 acres at an average price of $29.32 per acre for white farmers with option-lease contracts. The same condition is true in the case of colored farmers; that is, the settlers with option-lease contracts are buying less land but are paying a higher price per acre for it than the settlers with purchase contracts.

There are several reasons why the prices paid per acre by settlers with option-lease contracts are above those paid by farmers with purchase contracts. One of the most important reasons is that the period of payment with the former contract exceeds the latter by approximately 3 years. In addition to these 3 years there is usually an initial 3-year period during which no payments are made. Another reason is that the down payment of from $100 to $200 to the vendor means cash to him at the time of occupancy, whereas the fact that no down payment is made under an option-lease contract until 3 years have elapsed makes it necessary to finance the entire purchase price over a longer period of time. Also, the fact that a man has an option-lease contract does not necessarily mean that he will buy the land after all or part of the option period has elapsed, whereas one who has entered into a purchase agreement is very likely to make a greater effort to remain on the farm. This element of uncertainty with regard to option-lease holders is a factor contributing to the higher prices per acre paid under this system. Finally, those potential owners who are able to make down payments are probably the better bargainers of the two groups and are able to get lower prices.

Both white and colored settlers have a very short period of time in which to pay for their farms, the average length of payment period being approximately 10 years from date of acceptance of the option (Table 6). This means that the settlers agree to pay off an average purchase price of about $1,200 at 6 per cent interest in 10 years in addition to building a house and barn and establishing improvements as well as meeting other necessary costs in connection with clearing land, growing crops, and maintaining their families. Most of the settlers hope to accomplish this feat by using only the money received from products taken off the land which they are contracting to buy. There is considerable question as to whether or not the farmers can ever pay for their farms out of the produce from the land, especially in view of the purchase prices, and the short length of time given them under existing contractual arrangements. At least 20 or 25 years would probably be required by the settlers to make the necessary payments.

The farmers paid 5 to 8 per cent interest on their land notes, the average rate being 6 per cent (Table 6). Settlers with option-lease contracts paid higher rates of interest by almost 1 per cent than did those with purchase contracts, principally because of the higher degree of risk attached to the former type of arrangement. As has been pointed out previously, interest is often paid on such items as lumber furnished by the vendor for construction of improvements, and taxes which the vendee fails to pay and which the vendor pays, in addition to interest on the purchase price of the land. It will be noted that the rate of interest on this long-term credit for purchase purposes is above the short-term rate of interest offered by the Farm Security Administration. If the settlers are expected to succeed in paying for their land, arrangements must be made to provide them with a much lower rate of interest as well as a

TABLE 6.—TERMS OF FARM ACQUISITION FOR NEW LAND SETTLERS, BY RACE, NORTHEASTERN LOUISIANA DELTA, 1939

ITEM	SETTLER GROUPS BY RACE					
	WHITE SETTLERS		COLORED SETTLERS		ALL SETTLERS	
	Average per farm	No. of farms	Average per farm	No. of farms	Average all settlers	Total No. of farms
Land bought (acres)	45	58	43	42	44	100
Purchase price (dollars)	1,253	56	1,181	42	1,222	98
Down payment (dollars)	223	13	291	4	239	17
Outstanding balance (dollars)	1,170	53	1,147	41	1,160	94
Terms of payment						
Amount per year (dollars)	155	44	125	38	141	82
Years to pay (number)	9.3	50	10.2	39	9.7	89
Interest rate (per cent)	6.4	53	5.5	42	6.0	95
Amount agreed to pay	*Dollars*	*No.*	*Dollars*	*No.*	*Dollars*	*No.*
First year	193	39	239	39	216	78
Second year	190	39	178	39	184	78
Third year	184	39	167	39	176	78
Fourth year	180	38	165	38	172	76
Fifth year	173	39	159	38	166	77

reduction in the price per acre for land and a lengthening of the time for completing payment.

Settlers agree to pay an average of slightly over $200 the first year in which a payment falls due, but because of the fact that interest is paid on smaller amounts each year, the payment due the fifth year has decreased until it is only $166 (Table 6). Even though some companies do follow the procedure of dividing the payments into 10 installments of equal amount, this is not the usual course of action. Settlers who agree to pay very high prices per acre of land ($40 per acre) experience great difficulty in meeting the annual payments as they come due. Since the annual payments are sufficiently small when the land is priced at from $10 to $20 per acre, the settlers are, of course, more likely to make the payments agreed upon than they are when the price is too high.

The value of the cutover woodland for a portion of the Northeastern Louisiana Delta, as determined from actual appraisals made by appraisers of the United States Department of Agriculture for approximately 600 tracts of land in the proposed Eudora Floodway, shows that a large part of the area was appraised at less than $8 per acre; thousands of acres were evaluated at $4 per acre, and available information indicates that large acreages can be purchased in blocks at prices ranging from $4 to $10 per acre. The areas with the higher evaluations are generally better drained naturally and contain lighter textured soils which have been deposited in greater quantities near the stream banks.

The discussion relative to amount of payments has been entirely about payments which the settlers are due to make and not those which they actually make. Since the settlers have been in the area an average of only 4 years and since no payments were due under the option-lease contracts in any of the first 3 years, it is rather difficult to demonstrate statistically whether or not these farmers as a whole are keeping up with their payments. However, many individual cases can be cited in which farmers who have been on the land for several years are experiencing great difficulty in making the payments agreed upon. Because of poor drainage or other hazards a settler often makes only enough to pay taxes and part or all of the interest, leaving the principal practically undiminished. The payment due the following year is the total due that year plus any unpaid amount that was previously due, thus making an extremely large sum due in that particular year. It is not unusual to find settlers who have been unable to make all of their annual payments for so many years that the amount currently due is over $1,000. It is, of course, impossible for such settlers to pay that amount out of their receipts from the sale of cotton produced on their tracts. Realizing this fact, one land company is now planning to refinance its clients and to spread the payments out over a longer period of time, but will require the same rate of interest and price of land from the settlers.

Repossession and Resale

Although the land vendors have a legal right to repossess the property occupied by many of their clients when they fail to make their payments, this procedure is not usually followed. Instead, the settlers feel that they are so overburdened with debt that they leave on their own initiative. Sometimes a settler will sell his equity in the farm to another prospective buyer for a few dollars, provided the vendor gives his consent, and this second settler takes up the original contract. In the event the settler finds no one to whom he can sell his equity, it becomes the duty of the land sales department to get another settler who will attempt to clear and pay for the land. This may take place as many as three or four times before a settler is found who is successful in remaining on the land. Such has been the history of land-clearing operations in the United States. In instances where a settler sells his equity in the farm, he usually has built a house and barn at his own labor expense, as well as expended considerable effort in clearing several acres of land, yet he considers himself fortunate if he gets $50 to $75 compensation from the incoming settler for such improvements. Unless the outgoing settler finds someone to buy out his equity, the land vendors feel that they should not compensate him at all, since he has had the free use of the land for the time he has been there. It is true that in some cases the settler may have made several payments and then been forced to relinquish his claim with little or no compensation, but this is the exception rather than the rule. Almost all of the settlers who leave have paid only a very small portion, if any, of the amount which they were supposed to pay. Should the vendors of land wish to carry out the provisions of the contract to the letter, however, land of many settlers could be repossessed, even though the settlers had paid quite a considerable portion of the principal.

Whenever a land company "resells" a tract of land two or three times, it is able to increase the price each time because the improvements placed there by the previous settler add to its value. In one instance a tract of land covering approximately 3 sections had been nearly all sold in small units, and within a period of 3 years improvements valued at $10,000 had been made. Although the company had received very little money, the land was being cleared and otherwise improved and the company was relieved from paying taxes on most of the acreage. Since it is obvious that farm land is worth more after it has been cleared and buildings placed upon it, it appears rather unfair to the first settler for the vendor to receive all the benefit from increments in value due largely to the settler's effort. A more equitable arrangement would be a contractual provision for the vendor to compensate the vendee for unexhausted improvements and for the vendee to pay the vendor for any depreciation due to negligence—the amount to be determined by an arbitration committee, one member of which is selected by each of the contracting parties and a third by the first two selected.

Cost of and Value Added by Clearing and Improvements

According to the terms of the contracts, the settlers are supposed to clear an average of 5 acres per year during the first three years; however, the actual acreage cleared each year usually exceeds 5 acres. The settlers estimate the average total clearing cost per acre to be $17, of which $1 is spent for tree poison and $2 for other cash costs, the remaining $14 being non-cash costs—largely labor. Since the settlers actually clear 9 acres during the first year on the farm, their total clearing costs per farm for the first year are $153, of which amount $27 is cash. The settlers have cleared 25 acres per farm at a total cost of $415 and a cash cost of $75.

Interviews with 100 farmers indicate that 83 constructed dwellings at an average cash cost of $138 per house; 69 built barns costing $21 each and provided wells costing $18 each. The fact that negroes expend less cash on their buildings than do the whites is reflected directly in the comparatively lower quality improvements possessed by the negroes. The cost figures cited in Table 7 are costs which the settler has to pay either at the time of construction or at a later date through some credit arrangement.

The settlers come into the area with very little cash and usually contract for tracts on which there have been no fencing, no land cleared, and no improvements established. Because the land was previously occupied by settlers who failed in their attempt to buy it, 15 per cent of the farms have a house and a few acres of cleared land. Only 1 negro out of 20 enters a place on which some improvements have been made previously, whereas 1 white farmer out of every 5 contracts for such a farm. Usually

TABLE 7.—CASH COSTS OF IMPROVEMENTS FOR NEW SETTLERS, BY RACE, NORTHEASTERN LOUISIANA DELTA, 1939

ITEM	SETTLER GROUPS BY RACE					
	WHITE SETTLERS		COLORED SETTLERS		ALL SETTLERS	
	Average cost per farm	Number of farms	Average cost per farm	Number of farms	Average cost all settlers	Total number of farms
	Dollars	*Number*	*Dollars*	*Number*	*Dollars*	*Number*
Cash costs of improvements						
House	163	46	107	37	138	83
Barn	30	36	12	33	21	69
Poultry house	4	11	5	12	5	23
Tenant houses	233	10	102	5	189	15
Other houses	9	12	5	5	8	17
Well	20	39	15	30	18	69

at the time of purchase more land has been cleared and more improvements have been established on the large tracts than on the small.

One out of every 2 of the new settlers was virtually without cash when he entered on the cutover land, and of those reporting cash at the time of purchase, the average was only $162. Since the settler must build a house and often has to purchase work stock or other livestock, even the small amount of cash owned by half of the settlers does not admit of much working capital with which to make a crop the initial year, or to provide the bare necessities of life for the settler and his family. A settler's chances for success would be greatly enhanced if, before attempting purchase of the land, he had a sufficient amount of money to meet the cash costs involved in establishing improvements, clearing the land, making the initial crop, and providing adequate food and clothing for himself and his family during the first year on the farm. He should also have adequate numbers of work stock and other livestock, as well as the necessary tools and equipment. Because of the inability of the settler to make money elsewhere, it would be futile to recommend that he have in his possession the necessary amount of money for these purposes when he enters into a contract. Although the possession of cash at the time of purchase would be desirable, it seems that a more practical way of directing settlement would be to devise a system of liberal credit during the initial years.

The argument might be advanced that, since the vendor is furnishing the land, as long as the settler fails to pay, he is a liability. It is true that in the case of option-lease contracts a vendor gets as pay for the land only the clearing which is done and the improvements that are established; however, these acts on the part of the settler add very materially to the value of the land to the vendor. After the 3 years have elapsed, the vendor receives interest on his investment at a liberal interest rate, gets the taxes paid, and has more land cleared even though he may receive no part of the principal. In this way a vendor of land has his land improved at very little cost to him and at the same time owns the greater portion of the equity, namely, the right to repossess the land and resell it at prices far above those paid for cutover lands now at his disposal.

Although the value of the property which the settler is attempting to buy has increased considerably and although the settler has experienced gain in net worth—all of which will accrue to the land vendor if the settler fails—the operator's indebtedness was more in 1939 than it was at the time of purchase (Table 8). Ninety per cent of the $868 increase in value of all property was due to the extra value of the cleared land and to the addition of buildings, all of which still belongs to the land vendor in most cases. But the new settler has incurred debts in connection with establishing improvements, purchasing work stock, and making crops, thereby making his indebtedness approximately $125 greater in 1939 after 4 years on the farm than it was at the time of purchase. This does

TABLE 8.—INVENTORY CHANGES FOR NEW LAND SETTLERS, NORTHEASTERN LOUISIANA DELTA, BY RACE, FROM DATE OF PURCHASE TO SEPTEMBER, 1939

ITEM	SETTLER GROUPS BY RACE		
	WHITE SETTLERS	COLORED SETTLERS	ALL SETTLERS
	Average of 58 reporting	Average of 42 reporting	Average of 100 reporting
Acreage in farm	45	42	44
Years on farm	3.9	3.7	3.8
	Acres	*Acres*	*Acres*
Amount in cultivation			
At purchase	4	1	3
1939	25	22	24
Amount of fencing			
At purchase	.07	0	.04
1939	7.2	2.9	5.4
	Dollars	*Dollars*	*Dollars*
Value land and buildings			
At purchase	1,288	1,165	1,236
1939	2,344	1,902	2,159
Value buildings			
At purchase	50	7	32
1939	413	264	351
Value all property			
At purchase	1,619	1,512	1,574
1939	2,791	2,281	2,577
Operator's indebtedness			
At purchase	1,234	1,155	1,201
1939	1,303	1,289	1,324
Increase in net worth	1,054	636	868
Cash at purchase	79	88	83

not necessarily mean that the new settlers are making no progress, for much of the increased indebtedness can be accounted for by recent purchase of work stock and equipment. At the same time clearing the land and establishing improvements increases the value of the property to the vendor.

INTERNAL FARM ORGANIZATION

The only type of farming in the area is one in which cotton is the primary cash crop. Thus, a bad cotton year means many hardships for the new settler, who, unlike the established farmers or planters, has no financial reserve. He not only cannot make the payment due that year on his land, but also may experience difficulty in providing the necessary food and clothing for his family.

Receipts and Expenses

The settlers who were interviewed in connection with this study received three-fourths of their farm receipts and over two-thirds of their total receipts from cotton sales, while the A.A.A. payments made on cotton amounted to 21.1 per cent of the farm receipts and to 19.5 per cent of the total receipts (Table 10). Less than 1 per cent of the receipts were from livestock, and less than 9 per cent came from non-farm sources, principally outside labor. Outside employment opportunities are slightly more favorable in Madison and Tensas parishes than in East Carroll Parish, owing primarily to the existence of sawmills in those two parishes. Although there is very little difference between white and colored farmers in the percentage of receipts from the various sources, there is considerable variation in the amount of actual income received by the two groups. The white farmers interviewed had total receipts of $465 per farm as compared with an average of $266 per farm for the colored group. There is little difference between the two groups, however, in total expenses per farm, which means that the net farm income of $372 on farms operated by white people was almost $200 in excess of that on farms managed by negroes (Table 9).

The question arises as to why the negroes receive much lower incomes than do whites on similar tracts of land. Both races are buying approximately the same size tracts of land, but the white farmers are clearing more of their land for crops than are the negroes. This is evidenced by the fact that the average size of tract bought by white farmers is a 46-acre block, while the tracts which the negroes are attempting to buy average 43 acres in size. On the other hand, the whites are clearing about 25 acres on their tracts, whereas the negroes clear only 18 acres. Of this additional 7 acres cleared by white farmers, 2 acres are planted to cotton and 5 acres to corn. A large portion of the higher incomes made by whites is accounted for by the additional acreage of cotton. The white farmers also have non-farm receipts in excess of those reported by colored farmers. There is little difference in the amount of receipts each

TABLE 9.—SOURCE AND AMOUNT OF RECEIPTS AND EXPENSES FOR NEW LAND SETTLERS, BY RACE, NORTHEASTERN LOUISIANA DELTA, 1938

ITEM	SETTLER GROUPS BY RACE					
	COLORED SETTLERS		WHITE SETTLERS		ALL SETTLERS	
	Average per farm	Number of farms	Average per farm	Number of farms	Average per farm	Number of farms
	Dollars	*Number*	*Dollars*	*Number*	*Dollars*	*Number*
Receipts:						
Cotton and cottonseed	180	38	320	42	254	80
Livestock and livestock products	1	38	2	42	2	80
A. A. A.	59	38	83	42	72	80
Other farm receipts	4	38	18	42	11	80
Total farm receipts	244	38	424	42	338	80
Non-farm receipts	22	38	42	42	32	80
TOTAL RECEIPTS	266	38	465	42	370	80
Expenses:						
Labor	5	38	19	39	12	77
Feed	19	38	15	39	17	77
Seed	6	38	4	39	5	77
Poison	11	38	11	39	11	77
Ginning	18	38	25	39	22	77
Taxes	13	38	6	39	10	77
Other	0	38	10	39	5	77
TOTAL EXPENSES	73	38	93	41	83	79
Farm receipts less farm expenses	171	38	331	. .	254	. .
Total receipts less farm expenses	193	38	372	. .	286	. .
Value of products used at home	155	38	170	43	159	81

TABLE 10.—PERCENTAGE DISTRIBUTION OF INCOME FROM VARIOUS SOURCES FOR NEW LAND SETTLERS, BY RACE, NORTHEASTERN LOUISIANA DELTA, 1938

INCOME ITEMS	DISTRIBUTION OF INCOME BY RACE		
	Colored settlers	White settlers	All settlers
	Per cent	*Per cent*	*Per cent*
Percentage of			
Farm receipts from cotton	73.9	75.6	75.0
Total receipts from cotton	67.8	68.9	68.5
Farm receipts from A. A. A.	24,0	19.5	21.1
Total receipts from A. A. A.	22.1	17.8	19.3
Farm receipts from livestock	0.6	0.5	0.5
Total receipts from livestock	0.5	0.5	0.5
Total income from non-farm sources	8.2	8.9	8.7
Ratio of products used at home to farm income [1]	86.0	53.9	64.3

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[1] Farm income equals farm receipts less farm expenses.

group received from livestock or from other farm products. In addition to having more cotton acreage than the negroes, the whites make better yields per acre, partly because of better managerial ability and partly because of the fact that they are located on lands which are better drained.

Food and Feed Crops

Although cotton farming is the predominant enterprise in the area, corn, truck crops, and alfalfa can be produced on the fertile alluvial lands. Oats also do well, but they are not grown to any great extent, principally because the new land is too rough for oat production and because the small scale of farming does not permit the utilization of an extensive crop for cash income. The agricultural agents in the area are encouraging the growing of oats and are suggesting cooperatively owned machinery for use in their production.

Most of the farmers do not grow a sufficient amount of food and feed crops for their family needs, particularly in view of the hazards accompanying new settlement. Since they have sufficient land and, in many cases enough available time in which to grow ample supplies of truck crops, hogs, chickens, and other essential products for home use, such a condition is in need of immediate correction. The argument against growing cash crops other than cotton is that of inadequate marketing organization. In spite of this, it appears that all new settlers could certainly profit by growing the food and feed crops that they consume, and, where enough family labor is available, attempt to secure supplementary income from such sources.

Cropping System

The average settler in the area had a crop organization in 1939 which consisted of 9.1 acres of cotton, 9.8 acres of corn, 1.4 acres of feed crops, 1.1 acres of truck crops, and 24.2 total crop acres (Table 11). As has been pointed out previously, the essential difference between the crop organization of white and colored settlers is slightly larger acreages of cotton and corn on the farms operated by white settlers. The small difference of 2 acres in cotton, however, is very significant because it is this difference that accounts for the incomes of white farmers being considerably higher than the incomes of the colored farmers. The income from the sale of cotton plus the A.A.A. payment on the additional 2 acres can easily increase the new settler's cash income by more than $100 in a favorable crop year. Although the only change which the settlers themselves wish to make in their crop organization is to increase their cotton acreage from the average of 9 acres, which they now grow, to 15 acres, certainly other desirable changes could be made, such as a greater production of feed crops.

It is true that almost all of the settlers have one cow, two hogs for meat, and a few chickens, yet few of them have a brood sow, a sufficient number of poultry, or a year-around milk supply. The livestock organization of

TABLE 11.—CROP HISTORY FOR NEW LAND SETTLERS, BY RACE, NORTHEASTERN LOUISIANA DELTA, 1938 AND 1939

Item	SETTLER GROUPS BY RACE					
	WHITE SETTLERS		COLORED SETTLERS		ALL SETTLERS	
	Average per farm	Number of farms	Average per farm	Number of farms	Average per farm	Total number of farms
	Acres	*Number*	*Acres*	*Number*	*Acres*	*Number*
1938 crop history						
Cotton	9.0	44	7.1	39	8.1	83
Corn	12.3	44	7.6	39	10.1	83
Feed crops	1.5	44	1.1	39	1.3	83
Truck crops	1.0	44	1.1	39	1.1	83
Total crop land	25.2	44	18.1	39	21.8	83
1939 crop history						
Cotton	10.1	55	7.9	42	9.1	97
Corn	11.9	55	9.3	42	9.8	97
Feed crops	1.5	55	1.3	42	1.4	97
Truck crops	1.1	55	1.2	42	1.1	97
Total crop land	26.1	55	21.6	42	24.2	97
Previous usual cotton acreage	15.1	47	14.7	40	14.9	87
Cotton acreage wanted	14.6	58	14.7	42	14.6	100

new farmers should be expanded to such a point that they have a supply of meat, eggs, milk, and butter sufficient for home use, as well as a few calves, pigs, or fryers to market. As a source of cash income on the new-ground farms, livestock production at present is practically non-existent as evidenced by the fact that less than 1 per cent of the total cash income is derived from livestock and livestock products.

Size of Farm

There is a very significant relationship between size of farm as measured by total acreage, and income. The farms of less than 30 acres in size have farm receipts which are $155 in excess of farm expenses, while those with over 70 acres have farm receipts which exceed farm expenses by $515. The principal reason for this difference is that the large farms have an average of 19 acres of cotton compared with only 5 acres on the small tracts. Although cash expenses on the larger tracts are greater, they are not sufficiently larger to offset the increase in receipts. A large portion of the cash expenses on new-ground farms is fixed, and up to a certain point, additional land and additional cotton do not result in a very great increase in operating expenses. In view of this fact, it seems that a settler should buy as large a block of land as he feels he will be able to farm with a minimum of outside labor. For most settlers, 40 acres is a desirable sized unit for such operation as a cotton farm. The 20-acre tracts which the farmers are now purchasing are definitely too small for economical operation, and the 60-acre blocks are too large for the settler to handle as cotton farms without hiring considerable outside labor. Forty acres would be large enough to allow 15 acres for the planting of cotton without exceeding the A.A.A. restriction on the parish percentage of crop land if all but 2 or 3 acres are cleared, and at the same time leave sufficient acreage for corn and other feed and truck crops. It may be necessary, however, for many of the settlers to buy tracts 45 to 50 acres in size in order to have sufficient land suitable for clearing from the standpoint of drainage.

The farmers with the highest value of products used at home have the largest farms observed. This fails to support the contention that if a man has a large acreage of cotton, he will neglect his garden and other foodstuffs in favor of his cotton. In fact, the small farms have a higher percentage of the crop land in cotton than do the large farms. The farmers with larger acreages devote more time and effort to the production of feed crops, truck crops, and other supplementary crops than do the farmers with the smaller acreages.

Managerial Problems

The new settler indicates that one of his biggest problems is in getting an adequate cotton allotment. Farmers wish to plant approximately the same amount of cotton on the farms they are attempting to buy as they grew prior to coming to their present farm. The average previous cotton acreage was 14.9 acres per farm, and the farmers estimate that 14.6 acres are necessary in order for them to be able to meet their land notes and current operating expenses. These people have become accustomed to growing about 15 acres of cotton as tenants and croppers, and that acreage still influences their thinking after a change in tenure status has occurred. The acreage which the farmers desire to have in cotton is 60 per cent greater than that which they now have devoted to the crop; thus, if the settlers had the cotton acreages which they consider necessary, the newly established farms would increase noticeably the cotton production in the Mississippi Delta, but would not add significantly to the total United States production.

A weak farm organization, rather low in cotton yields, inadequate production of food and feed crops, and absence of supplementary sources of income may be evidences of the poor managerial ability of these settlers, especially of the colored settlers. On the other hand these conditions may be the result of a maladjustment between capital and the land resources in the area. Nevertheless, many of the settlers never owned any land before they attempted to buy their present farms and, as a result, have had very little managerial experience. Such settlers need more guidance than the well-established farmers. This would mean more than they are now getting. There is need for someone well trained in farm management, and familiar with cotton farming as well as live-at-home farming in the Delta area, to develop farm and home plans with the settlers, supervise the execution of such plans, and assist the settlers in an advisory capacity in every possible way.

SEASONAL CREDIT

Most new settlers in the Delta found it necessary to borrow money with which to make their crops each year, the principal sources of credit being the Farm Security Administration, individuals, and local banks. Of the 100 farmers interviewed, 73 had borrowed an average of $213 each with which to make their 1938 crop. Approximately one-half of the borrowers obtained loans through the Farm Security Administration; about one-third secured loans through local individuals; and the remainder borrowed from local banks (Table 12). It is apparent, therefore, that the Farm Security Administration is playing an important role in the furthering of new settlement.

TABLE 12.—Seasonal Credit Arrangements Made by New Land Settlers, by Race, Northeastern Louisiana Delta, 1938

Source of credit	Settler groups by race					
	White settlers		Colored settlers		All settlers	
	Average per farm	Number of farms	Average per farm	Number of farms	Average per farm	Number of farms
Individual						
Amount (dollars)	299	7	145	16	192	23
Rate (per cent)	8	5	12	16	11	21
Unpaid [1] (dollars)	400	1	44	6	95	7
Local bank.						
Amount (dollars)	177	7	101	8	137	15
Rate (per cent)	8	7	9	8	8	15
Unpaid [1] (dollars)	0	0	32	2	32	2
F. S. A.						
Amount (dollars)	265	17	170	18	216	35
Rate (per cent)	5	17	5	16	5	33
Unpaid [1] (dollars)	143	15	129	11	137	26
Total making loans						
Amount (dollars)	266	35	165	38	213	73
Unpaid [1] (dollars)	152	17	92	19	120	36

[1] Unpaid as of September 1, 1939.

Although a larger proportion of colored farmers obtained loans than did white farmers, their loans were much smaller. Ninety per cent of the negroes borrowed money in 1938 as compared with 60 per cent of the white farmers; but the loans of the former group averaged only $165 per farmer, whereas those of the latter group averaged $266. The principal reason why the colored farmer borrowed less money than the white farmer was that he needed less money to support his family at his lower standard of living, rather than that the colored farmer used appreciably less cash to operate his farm.

About as large a proportion of the negroes borrowed money from the Farm Security Administration as did the whites, but a much greater percentage of negro than white farmers acquired loans through individuals. This variance was probably a result of the fact that many of the negroes came from plantations where they had been croppers relying upon credit from plantation owners, and for some reason still used that source of credit after leaving the owner's farm. Several of them preferred to continue reliance upon individual credit. Because their small cotton acreage and other factors made it hard for them to qualify for loans, many of the negroes did not borrow from the Farm Security Administration. White farmers as a rule, however, borrowed from the Farm Security Administration whenever possible.

A comparison of rates of interest revealed that, except for loans obtained through the Farm Security Administration and banks, colored farmers paid higher interest rates than did white farmers, and that for farmers of both races the Farm Security Administration offered the most economical source of credit.

Individuals charged colored farmers higher interest rates, because they considered them poorer risks, because they knew that they had been accustomed to paying exorbitant rates in the past, and because they felt certain that they would be reluctant to object to such rates. Furthermore, since many of the negro and a few of the white farmers had no conception of how many dollars they actually paid as interest, rates did not, of course, impress them.

Although local Farm Security Administration supervisors indicated that new settlers were able to repay almost all of the money they borrowed, the farmers interviewed had repaid only 37 per cent of their 1938 loans by September, 1939, almost a year after the due date for most loans. Since part of the money borrowed in 1938 was to be repaid over a period of 4 or 5 years, the low percentage of repayment must not be interpreted too literally; nevertheless, a high percentage of the loans was made for the current crop year and was to have been repaid prior to the time the farmers were interviewed. Approximately one-half of the loans made in 1938 by individuals and about three-fourths of those made by local banks had been repaid by September 1, 1939. It is evident, therefore, that new settlers have experienced considerable difficulty in meeting their short-term credit obligations.

The longer the time a settler had been on his farm, the larger the amount of money he had borrowed. Farmers who had been on their farms only one year in 1938 borrowed an average of $54. With additional years on the farm this amount gradually increased to an average of $338 borrowed by farmers who had been on the farm 5 years. The primary reason for the settlers' borrowing more money with an increasing number of years on the farm was that they were able to get larger loans based upon greater cotton acreages.

After a farmer had made 2 or 3 crops on his farm and had increased his cotton acreage to 7 or 8 acres, he could usually get from the Farm Security Administration a loan sufficiently large to enable him to make his crop and meet living expenses until he sold his cotton. The new farmer, however, found it very difficult to secure money the first year. The farmer whose cotton allotment was frozen at 4 or 5 acres also found it difficult to secure adequate credit at reasonable rates. Although it would have been very helpful for the new settler to have had enough money with which to make his first crop before he attempted to buy land, this was seldom the case.

The majority of new settlers who came into the area with no livestock found the Farm Security Administration to be the best agency for livestock loans. Because the Farm Security Administration was very lenient in making loans of this type after the first crop year, very few of the new farmers were handicapped by a lack of work stock.

The newcomer should be provided with more desirable seasonal credit during the first few years. Farmers who borrow from individuals and pay high rates of interest should be advised of the possibility of securing loans at lower rates through the Farm Security Administration.

DIFFICULTIES ENCOUNTERED UNDER THE A.A.A. COTTON PROGRAM

The current rapid settlement on the cutover Delta lands of the lower Mississippi River Valley has produced a series of increasing difficulties affecting both the individual settler and the A.A.A. cotton adjustment program. Aside from the usual physical problems confronting the establishment of a permanent agriculture on rich, but poorly drained, alluvial lands, the new settler faces serious difficulties in securing a cotton allotment which is adequate to provide income for minimum living expenses, for payments on land, and for other farm expenses. Since parish allotments remain rather constant from year to year, any increase in acreage to new farms must ultimately produce a corresponding decrease on old farms. The latter condition necessarily produces friction in the local administrative machinery of the A.A.A.

Because of the large amount of time required to clear land and establish essential improvements during the first year or two, most new farmers planted small acreages, and since the Agricultural Adjustment Act of 1938 limits the cotton acreage on any farm to the highest cotton acreage planted plus that diverted in any of the past three years, many new settlers have allotments considerably lower than that which the parish percentage of crop land allows. The settlers were not usually aware of this statutory limitation when they planted their first cotton crop on new land, and made no effort to plant fully up to the parish percentage of crop land. Thus, many settlers find themselves permanently limited to 4 or 5 acres of cotton, regardless of the additional crop land obtained through clearing. This group, in order to obtain allotments in proportion to those of old farms, will have to remain out of the program a year. That is, they will have to overplant intentionally for one year in order to establish a planted history of sufficient acreage to allow them thereafter to produce up to the parish percentage of crop land. Very few farmers follow this procedure simply because they feel, or are advised, that they cannot afford to pay the penalties which would be invoked. Any person who knowingly plants cotton on his farm in excess of the cotton allotment for the farm is ineligible for any A.A.A. payment for that year and is also subject to a penalty of 3 cents per pound for cotton marketed in excess of the farm marketing quota[10] for the farm on which such cotton is produced. Any person who unknowingly and unintentionally plants acreage in excess of the allotment will receive a payment, but only after a deduction at the rate of 4 cents for each pound of the normal yield of the excess acres.[11]

While it is true that, calculated on the basis of one year, the penalties would undoubtedly be too great for the average settler to bear, it is erroneous to consider such losses over a 1-year period. Because the establishment of a cotton history in any one year would permit in succeeding years an allotment equal to the parish percentage of crop land, from an accounting point of view any loss resulting from non-participation in the program for one year should be distributed over succeeding crop years. However, new farmers without any financial reserve are inclined to estimate losses in terms of the current crop year, and it is the first years on the new farm that are the most difficult. There is also a risk involved because the new settler has no insurance that the provisions of the agricultural program with respect to new cotton land may not be changed for any of the succeeding crop years.

Since eventually the burden of staying within the A.A.A. cotton program becomes too great to bear, a few settlers manage to drop out for a year in order to establish a larger cotton history. When they do, the calculations upon which such a decision is made include only cash costs of production. Without recommending to the settler what procedure he should follow, a mathematical demonstration will indicate the possible costs and benefits in connection with overplanting. The typical new settler in East Carroll Parish on a 40-acre tract wishes to clear 35 acres of that amount and plant the equivalent of the parish percentage of crop land to cotton. As the parish percentage of crop land for 1940 is 37.21, this will give him an allotment of approximately 13.0 acres. The average cotton allotment on the new farms in 1940 is 5.5 acres, and the base yield for such farms is 252 pounds. If the new farmer chooses to overplant his allotment to the extent of the parish percentage, he will be penalized $56.70 (7.5 excess acres x 252 pounds x 3 cents per pound). His 1940 conservation payment on the 5.5 acres will be $22.17 (5.5 acres x 252 pounds x 1.6 cents) if he complies with the program. Thus, the farmer will of necessity pay $78.87 for the privilege of planting 7.5 acres excess cotton. This does not take into consideration the fact that he will also lose any price adjustment or soil-building payments which he might have received had he remained in the program.

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[10] The farm marketing quota for 1940 is the normal production (average for 1935-39, adjusted for abnormal weather conditions) or the actual production, whichever is the greater, plus the amount of any carryover penalty-free cotton. Since this manuscript was prepared the penalty has been increased to 50 per cent of the loan to cooperators, or about 7 cents per pound.

[11] The denial of benefit payments with respect to cotton on all farms on which cotton was not planted in any of the years 1938, 1939, and 1940 goes into effect in 1941. In previous years new producers who did not intentionally overplant were eligible for benefit payments.

The question might well be raised at this time as to whether the income from the 7.5 excess acres will be sufficient to enable the farmer to pay the above penalty plus costs of production. In order to make such an estimate, it is necessary to assume that actual yields will approximate base yields as well as to assume a stipulated price of cotton, say 10 cents per pound. Based upon these assumptions, the gross income from lint cotton on the excess acreage will be approximately $189.00 (252 x 7.5 x 10 cents). This will leave a balance of $110.13 with which the farmer may cover the costs of production on the 7.5 acres of excess cotton if the loss of the A.A.A. payment amounting to $22.17 is considered a cost. From a strictly accounting standpoint, this payment probably should be considered an expense, and to the individual farmer it is a loss which he definitely realizes, although it is not really a cash cost in the same sense as the penalty of 3 cents per pound. If this is not considered a cost, there will be a balance of $132.30 with which to cover costs of production on the 7.5 acres. In the one case the farmer will be growing cotton for approximately 6 cents per pound and in the other for about 7 cents per pound.

The question now arises as to whether or not the farmer can afford to grow cotton at this price. In order to determine this with a fair degree of accuracy, it will be well to determine what additional costs will be incurred by his growing 13 acres of cotton instead of 5.5 acres. It seems that the farmer's overhead cash costs will be essentially the same for 13 acres of cotton as with 5.5 acres. He has plenty of land available for the additional 7.5 acres, although at present the problem of having sufficient land adequately drained for cotton production might become a great difficulty. Any successful expansion of cotton acreage in the Delta will have to be preceded by a more adequate drainage system than now exists. It should not be necessary for the farmer to buy more work stock or equipment with which to make this larger crop; consequently, there will be no need for any additional buildings. The largest items of cash cost in cotton production are ginning costs and labor, especially that labor hired in connection with picking and chopping. It is commonly held that income from the seed will be sufficient to cover ginning costs. Inasmuch as no account was taken of income derived from cotton seed in the illustration above, the ginning expenses may be omitted as a cost, since the two will offset each other. Because farmers in this area use no commercial fertilizer in cotton production, the major items of cost other than labor are seed and poison. Seed costs for the acreage should not be over $5, and poison costs should not exceed $25.

All major costs associated with an additional 7.5 acres cotton have been discussed except labor costs. The amount of hired labor that will be necessary will of course depend to quite a great extent upon the number in the family capable of helping with the crop and upon the industriousness of the operator. The average settler in the area is 44 years of age, and the usual size of his family is 5 persons. In only 1 family out of 5 is there found among the three children a boy over 16 who is still at home. This means that the farmer will very likely be compelled to hire some additional labor to chop and pick cotton. If, however, the farmer is a hard worker and devotes as much of his time as possible to the crop, he should be able to keep the labor, seed, and poison costs approximately within the $110.13 or at least within the $132.30 figure previously determined.

Although at present the farmers are clearing only from 20 to 25 acres on their 40-acre tracts, as was pointed out above, they would clear up to 35 acres, or 87.5 per cent of their holding, if they could get a greater cotton allotment. In order to be able to get an allotment of 13 acres of cotton, it will be necessary not only to have a planted history for that acreage established but also to have 35 acres in crop land, because the parish percentage of crop land will become a limiting factor if the crop acreage is not increased. This additional clearing will allow sufficient land for as great an acreage of crops as the farmer produced prior to the expansion in cotton production. Increasing the crop land in such manner will call for a greater labor expenditure; therefore, the amount which can be cleared will depend largely upon available family labor, unless a subsidy for land clearing is provided.

The underlying assumptions upon which this demonstration was based are that the actual yield will approximate the normal yield of 252 pounds, that the price of cotton will be 10 cents per pound, and that the provisions of the cotton program will remain unchanged. Any increase in price (it has increased since above calculations were made) or in yield will strengthen the farmer's chances for covering costs; however, a decrease in price, a decrease in yield or increase in penalty (increased since above calculations were made) will have the opposite effect. As for rates of production, yields of below 250 pounds in the Delta are very poor; however, those on the new-ground farms the first year are only 60 per cent of those on the old farms. Yields on heavy-textured new-ground soils in the Delta increase each year of cropping for 6 or 8 years, after which time they will decline unless the land is planted to legumes regularly and plowed deeply. It is logical to assume that yields on new-ground farms will be higher than the 252 pounds determined on the normal yield for those farms growing cotton for the first time.

SOCIAL ASPECTS OF NEW GROUND SETTLEMENT

The average new settler in the Delta was born on a farm and has always lived on a farm as a hired man, cropper, renter, or owner of a small holding, until he found the cutover Delta tract he is now attempting to buy. An insignificant number of the new settlers came from other occupations than farming. Eighty-one per cent of those interviewed came from Louisiana and Mississippi, while the remainder were from Arkansas, Alabama, Texas, Florida, Missouri, North Carolina, and Tennessee.

Each family has, on the average, three children, one of which is away from home, married or working elsewhere. There is no significant difference between the number of children in white and colored families. The presence of boys of 16 years of age or older adds materially to the man power available for clearing land and for farm work; 21 of the 100 families interviewed have a total of 28 boys 16 years of age or older at home.

In an area where "buckshot" soil predominates, dirt roads are fairly good in dry weather, but are an impassable mire for motor vehicles and difficult of passage even by wagon and team in wet weather. Three out of 10 of the new settlers possess motor vehicles. The colored settlers have more than two miles of buckshot-clay road, while the white families have less than a mile. The white families live slightly more than 12 miles from their village market, while the colored families live only 9 miles. With the exception of the dirt connecting roads, other roads in the area are first-class gravel or paved highways. Although the police juries seem to be making rapid progress in meeting local road needs, it does not appear that any comprehensive road system for newly developed areas has been planned, but rather that demands for extension and improvement are met as they arise.

The white families in the newly settled area are 3 miles from a grade school and almost 9 miles from a high school; however, they are served by a school bus that comes within approximately one-half mile of their homes. Although the availability of schools for white children, in general, seems to be adequate, a few families live from 2 to 5 miles from a school bus route, indicating a need for other bus routes or nearby schools.

While the colored families are less than 2 miles from a grade school and slightly more than 9 miles from a high school, school buses for colored children are not provided in the area, making it very difficult for negroes to get more than a grade school education. In the newly settled areas additional schools for negroes are obviously necessary.

The average white farm operator has completed six grades in school and his wife seven grades; the colored farm operator has completed four grades and his wife five grades. Although the children of the new settlers will probably have an opportunity to get a better education than their parents, still additional facilities are necessary for the new settlers of both races.

Two-thirds of the houses occupied by the white families are rated only fair as to condition and general appearance; 10 per cent are rated as poor; almost 2 per cent are tents, thus indicating that housing conditions of the new settlers are far from desirable. Only 1 house out of every 5 occupied by white families is rated good, while just 1 out of every 20 among negro houses is rated good. Slightly more than one-half of the negro houses are rated only fair; approximately 40 per cent are poor, and 5 per cent are but tents. The houses are inadequate not only as to condition but as to size, screens, and sanitary facilities. Most families enter the area without adequate funds to build satisfactory houses, and where lumber companies provide the lumber, it is of poor quality and usually only enough is made available to provide a small dwelling. Poor housing conditions, then, are a further indication of the need for credit in the early stages of settlement and development of the cutover alluvial lands.

In looking for ownership and security the settlers naturally want good land and a profitable farm organization, and in moving into the Delta these people are led to believe that they will be prosperous and secure in a short time. In a study, made in Ward 2 of Tensas Parish, Louisiana,[12] of 135 individual farm operators who gave reasons for moving, slightly more than one-half moved for better land, better living quarters, a more profitable setup, or ownership and security. Other reasons given included institutional advantages, real or imagined injustices, escape from personal associations, lack of jobs, and psychological unrest. The same study revealed that two-thirds of the individual farm families moving into the Delta since 1930 had relatives already living in the area; therefore, when the cutover lands were put on the market in small units for farming purposes, the land selling agencies had little difficulty in reaching prospective purchasers.

In climbing the agricultural ladder from wage hand to owner, 18 per cent of the new settlers at some time prior to reaching their present status have made a backward shift in tenure. Reasons for such backward shifts have not been ascertained, but the data indicate that the higher the individuals climbed, the more precarious their positions became. The 18 per cent making backward shifts in tenure did so as follows: 3 per cent shifted from cropper to wage hand, 7 per cent from renter to cropper or wage hand, and 8 per cent from an owner status to renter or cropper. Perhaps the fact needing greatest emphasis is that 82 per cent of those interviewed and now having some degree of ownership have never made a backward shift. This does not mean that all of them have climbed the ladder rung by rung, for as a matter of fact, a large majority of the new settlers have skipped one or more tenure stages before making their present attempt at land purchase.

Approximately one-fourth of the new settlers have owned land at one time or another previous to moving into the Delta; 15 per cent owned land, usually in the hill areas, immediately preceding purchase of the cutover tracts they now occupy. Although specific information as to the reason for relinquishing ownership was not obtained in each case, the general impression was gained that the settlers' equity had been lost due to drought and crop failure on the eroded, infertile hill farms. These farmers, realizing their lack of security on such lands, left to seek better opportunities elsewhere.

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[12] Homer L. Hitt, "Recent Migration Into and Within the Mississippi Delta of Louisiana." Louisiana State University and Bureau of Agricultural Economics cooperating. Unpublished.

As is usually true when practical problems of economics involve adjustments of man to man, many socio-political problems are raised. In the Delta new groups with entirely different backgrounds in education, outlook on life, and economic status are finding it necessary to make adjustments to their neighbors, and vice versa. The number of registered voters with whom the politicians must deal is rapidly increasing in this area. In one parish a new settler is an A.A.A. community committeeman, and it is only natural that such representation of new settlers in affairs of community and parish interest shall increase. Although a few of the more progressive settlers are being prevailed upon to think in a manner similar to the planter, the majority of them still retain the thoughts characteristic of small farm operators or even tenants and croppers.

PUBLIC FINANCE PROBLEMS

Insofar as local taxation and finance are concerned, the new settlement taking place in the Northeastern Louisiana Delta presents no serious problems at present. As a result of homestead exemptions, of postponement of the re-classification of lands brought into agricultural production, and of state-wide systems of financing local services, the new settler who has secured a deed to his farm is relieved almost entirely of property tax payments; the established planters and farm operators feel no unusual property tax burden as a result of the influx of new settlers, and the parish finance structure is fairly well insulated against severe impacts resulting from demands for new or expanded local services. While local property taxpayers and parish governments are confronted with no acute finance problems attributable to new settlement, the State is experiencing a slowly growing demand upon its tax resources for homestead exemptions and education, and in the future may be pressed for greater expenditures for roads and public welfare activities. Since concentrated new settlement is apparently confined at present to a relatively small part of the State and since the State's tax resources have been greatly expanded in recent years by new levies and by constantly growing returns from old levies, the increased demands on the State treasury present potential rather than existent problems.

The principal public services demanded and provided in new settlement areas consist of roads, schools, public welfare and relief activities, drainage, and flood control. Since State and Federal-aid highways are designed to serve through-traffic and since they are financed wholly out of Federal and State revenues, they present no particular problem in new settlement areas even though their location may frequently be subject to local pressure arising from new settlement. Parish roads, on the other hand, are financed out of parish revenues; and, consequently, increasing pressures for the improvement or extension of such roads, conceivably growing out of new settlement, might eventually throw serious burdens on local government. Rural schools in Louisiana are supported jointly by local and State taxation, and, hence, any increases in these services resulting from new settlement are problems affecting both levels of government.

Although administered by boards that are nominally local in character, public welfare activities in Louisiana are financed and controlled by the State and Federal governments acting jointly through the State Department of Public Welfare. Relief, as distinguished from "public welfare activities," consists of aid extended to "employables," while public welfare assists "unemployables." Relief in areas of new settlement consists largely of locally-sponsored Work Projects Administration projects. However, since local contributions to these projects frequently consist only of supervision and materials, the bulk of the relief load may be considered to be borne by the Federal government.

The principal services provided by local units of government other than the parish are those relating to flood control, levee maintenance, and drainage. Although provision is made for the creation in Louisiana of road and school districts, in new settlement areas such districts are few, and, where they do exist, they function through the established parish authority. The reason for the creation of road and school districts is usually to make possible special tax levies for capital outlays.

Since the cost of major flood control construction projects, except for easements, rights-of-way, and damages, is now borne entirely by the Federal government, the only costs falling upon the levee districts are those arising out of the general maintenance of levees and the construction of projects which are purely local in character. Because the Northeastern Delta of Louisiana is already fairly well protected against flood by existing levees, cut-offs, and floodways, the services performed by levee districts are not likely to be subject to any demands arising from new settlement. Existing drainage districts, on the other hand, do not adequately meet the needs in areas of new settlement. Because drainage is a major problem affecting new-ground farming, the reorganization of drainage districts to serve more adequately the settlers moving into the Delta is of utmost importance.

At present, seven active districts in the area provide local drainage outlets. Only one district has experienced any serious financial difficulties, and these have now been overcome. Since an effective program in the area includes the development of a comprehensive system of drainage, it is apparent that, unless great care is exercised in the planning and administration of new districts, serious finance problems could very easily develop, particularly if the anticipated improved drainage does not result.

In conclusion, then, it is obvious that no serious problems of public finance, which currently affect local government, exist in new settlement areas although the roots of such future problems are clearly discernible. Unless settlement in the Delta is properly directed and planned so as to insure new farmers a reasonable degree of success, the State and parishes may find it difficult to satisfy increasing demands for roads and schools. Drainage districts, too, unless properly planned and administered, might very quickly find their obligations to bondholders difficult or impossible to meet.

The effects of new settlement are more apparent on the State than they are on the local government level. Increasing payments out of the State treasury for schools and property tax relief are indications of potential problems in the field of State budget balancing. While the slow shift in tax burdens from the parish to the State is not confined to areas of new settlement, it is obvious that where finances are provided by the State in response to need, such as in the case of schools, the burden on the State can be expected to increase in regions of new settlement more rapidly than in older sections of the State.

The potential public finance problems in areas of new settlement can be avoided by a planning process that foresees their development and insures that the land use and occupancy maladjustments which are at the root of such public finance problems do not occur. Specifically, such a planning process would discourage or prevent settlement on lands unsuited to agriculture and would thus preclude the development of uneconomic public services. In areas suited to settlement it would insure that roads and schools were efficiently developed and that undue optimism regarding future agricultural settlement did not result in excessive public services.

SUGGESTED PROGRAMS AND POLICIES

The problems arising from the new settlement now taking place in the Northeastern Louisiana Delta demand a carefully planned and administered program of action. The details of such a program and the adjustment of plans to fit local needs and attitudes are functions that are properly part of the county planning process. From this study it is apparent that certain general policies and programs of action would do much to insure the development of an economic and socially desirable pattern of settlement. Whether or not these policies and programs are adopted depends largely on existing statutory and administrative restrictions as well as the willingness of legislative groups and responsible officials to make needed changes.

At this early stage in the planning process in the Delta, it has been possible to obtain informed opinions from a very limited number of local people. For the most part, the programs and policies discussed below are confined to those regarding which there is fairly unanimous agreement. Numerous additional suggestions for programs and policies could be made but it is felt that some of the information which might lead to such suggestions should be presented to a larger number of local people in order that they may have an opportunity to express their opinions.

Unified Drainage System

The need for carefully conceived and administered programs and policies is greatest in areas suited to agricultural settlement. Since the most pressing physical problem facing new settlers is that of drainage, the recommendations contained in the section dealing with this problem should be effected at once. Particularly is it important that future efforts toward securing better drainage take cognizance of the need for a unified system incorporating all three parishes in the area. The plan for a unified drainage system would require the setting up of one large district and would provide for a reorganization of the seven existing districts into the new unified system. Existing authority permits the police juries of two or more parishes by joint action to create districts out of adjacent parts of parishes.[13] On the other hand, since the courts have held that no district may incorporate all of one parish,[14] if it should be necessary to include an entire parish in the system, legislative action would be necessary. However, since in general the front lands along the Mississippi River are adequately drained, it seems unlikely that the legal prohibition accompanying the incorporation of an entire parish would loom as a serious problem. The most difficult procedure in setting up a unified drainage system is the reorganization of existing districts into the single enlarged unit. Although adequate authority exists[15] for the type of reorganization proposed, the difficulty of securing a majority vote of landowners in each of the seven existing districts is apparent. Consequently, if any district is so organized that it will not impede seriously the development of the unified plan and at the same time will not benefit greatly from the institution of improved drainage, it might be permitted to remain independent. However, from present information it appears that the proposed drainage is so far-reaching in its effects throughout the basin that all land except that along the river is likely to benefit.

Planned Road and School System

Corollary to the need for well organized drainage is the necessity for planning a local road and school system that will serve adequately the demands of new settlers without incurring any of the costs attendant upon a haphazard growth of these facilities. Since roads in the Delta must be constructed with wide, deep ditches, they naturally serve as lateral drainage channels for adjoining lands; and, consequently, the road pattern needs to be integrated with the drainage system if the greatest economies are to be realized. An important part of a school planning program is to strike a balance between excessive consolidation on the one hand and too many inefficient one-room schools on the other. Important, too, is the fact that the planned location of roads and schools can serve to influence the settlement pattern even though it is obvious that such an influence will not wholly prevent the occupation of inaccessible or isolated tracts. Because the parish police jury and the parish school board have adequate existing authority[16] to plan the location of roads and schools, the preparation of such a plan can proceed at once even though other restrictive devices may have to await legislative action.

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[13] Cf. Carleton, R. L. *Local Government and Administration in Louisiana,* Louisiana State University Press, Baton Rouge (1935), p. 230.

[14] *Lacy* v. *Ottawa Banking Co.* 272 F - 448 (1920) .

[15] Carleton, R. L., *op. cit.,* p. 234.

Improved Purchase Contracts

In order to protect both the individual settler and society's interest in developing a reasonable degree of security for the farm family, the contracts being issued to settlers must be improved. Compared with the contracts now in use, a more satisfactory one would afford the following improvements:

1. Give the settler a warranty of title.
2. Protect whatever equity the settler may have in the land by virtue of principal payments, land clearing, buildings, and other improvements.
3. Provide for more reasonable terms in the period of payment, in the rate of interest, and in permitting the amount of payment to vary with crop success or failure.

It is obvious that the development of a desirable form of contract does not at all insure its use. Although an educational program in the area, particularly through the Extension Service, might serve to impress upon local people the advantages of securing an improved contract, unfortunately such a campaign would necessarily fail to reach most of the settlers coming into the area from other States and other parts of Louisiana. Hence, negotiations directly with the vendors seem to be the most satisfactory procedure for securing general adoption of a desirable contract form.

Reduced Land Prices

While improved contracts can do much to protect settlers, they can in no way reduce the present high prices charged for cutover land. Fundamentally, it is the exceptionally high price charged by vendors in selling lands that makes eventual payment seem impossible. Two courses of action seem desirable for reducing the price of land to new settlers. One is the establishment of a revolving fund for the purchase and resale of cutover lands by some such Federal agency as the Farm Security Administration, while the other is the establishment of a policy by the Farm Security Administration to give preferential treatment in its rehabilitation loan program to clients with good contracts that stipulate a reasonable price for land.

The revolving fund for the purchase and resale of land could either be set up directly as an administrative function of the Farm Security Administration, or could be established as a cooperative undertaking allowing settlers to become members of the organization as they sought to buy land.

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[16] Carleton, R. L., *op. cit.*, pp. 206-7.

From previous experience of the Federal government in buying or optioning cutover Delta lands and from indications received from present owners, it appears very likely that most of the land being settled could be bought in large blocks for from $5 to $15 an acre compared with the $25 to $40 an acre being charged the individual settler. While the government would have to add costs of handling and supervision to the price it paid for land, the net price to settlers would obviously still be considerably less than that now being charged. Included in the revolving fund procedure would be none of the required features of resettlement projects such as model buildings, electrification, or power equipment. Instead, settlers would be left free to make individual decisions as to the extent to which they wished assistance beyond that given for purchasing land. If a settler felt that he could carry the additional burden imposed by model housing, separate loans via current Farm Security Administration financing programs could be made. On the other hand, new farmers desiring to keep their annual cash obligations to a minimum could do so by keeping down their overhead costs.

The second method suggested for reducing the price of land and for inducing the adoption of better contracts, that of preferential treatment by the Farm Security Administration, offers the best opportunity for securing immediate action with reference to a rapidly growing problem. Since it is apparent that few settlers could manage to exist on cutover land during the first few crucial years without Farm Security Administration assistance, the Federal Government should insist that these expenditures be safeguarded and not be used merely to finance the clearing of lumber company land by destitute rural families. Consequently, by indicating to vendors of land that liberal assistance will be forthcoming only to settlers with proper contracts and reasonable land prices, the Farm Security Administration can do much to eliminate the current "subsidy" to speculative landowners and to protect the individual new-ground farmer's equity.

Although the programs and policies so far suggested may assist settlers who come into the Delta in the future to obtain fair land prices and reasonable terms, they can do little to aid farmers already heavily burdened with dubious purchase arrangements. This latter group will require a refinancing program either under the Farm Security Administration or the Federal Land Bank. While some settlers already in the Delta might be included in purchase areas and thus might be aided under the revolving fund by the government's taking over and refinancing their contracts, others would have to be handled as individual cases dealing directly with vendor and vendee under land bank refinancing procedures or under farm debt adjustment procedures.

Technical Assistance for New Farmers

To some degree all settlers are faced with the problem of making adjustments to new farming conditions and to a relatively new way of life. When families move to the Delta from the hills, they find physical conditions of the land different enough to require different farm equipment and need methods of husbandry largely unknown to them. In making the shift from a tenant or a cropper to a land-clearing settler, the new-ground farmer finds that he must produce more than a few acres of cotton and corn if he is to survive, that his Farm Security Administration financial assistance is predicated on a live-at-home program, and that the problem of farm planning falls directly upon him as his individual responsibility.

Most settlers are eager for information and advice on the new problems with which they must cope, but, unfortunately, except for small amounts of time which the county agricultural agents and the rural rehabilitation supervisors can divert from their office duties, most settlers must do without more than a nominal amount of counsel and supervision. Theoretically, of course, the rural rehabilitation supervisors should provide individual counseling, but in practice they are so burdened with office routine and heavy case loads that such assistance is small. Similarly, the county agents are supposedly available for the work indicated, but usually the problems of the established farmers and the greatly expanded farm programs of recent years serve to consume most of the time available to extension agents. In order, therefore, to make possible the additional individual assistance needed, some means should be found to employ extra personnel to advise the new-ground farmers with reference to their many farm problems. Such personnel would in effect be either assistant county agents or assistant rural rehabilitation supervisors "specializing" in and devoting their entire time to new-ground farming. Expenditures for such service might appear large in relation to the number of farm families it would actually reach, but in terms of safeguarding the government's financial and social investments in people, they will seem reasonable indeed.

Revisions in A.A.A. Cotton Program

Without in any way questioning the need for "doing something about cotton," this study has been based on what appears to be a reasonable assumption that for the next few years little can be expected in the way of changing the Cotton Belt from a one-crop economy to a more socially desirable type of farming. Consequently, in dealing with the problems of new settlement and in seeking means of survival for new-ground farmers, it has been necessary to assume that the only major source of cash income for farmers in the Delta is cotton. In view of this conclusion, therefore, the need for making changes in the A.A.A. cotton program to aid the proper development of new settlement is imperative. From the difficulties indicated in the section dealing with the A.A.A., it appears that the following policies should be instituted either by statutory amendment or by changes in administrative orders:

1. Provision should be made for such shifting of allotments between parishes and states in the Cotton Belt as may be administratively determined necessary because of the development of new lands.
2. Provision should be made for permitting administrative suspension, in the case of new settlers on fertile lands, of the application of Section 344 of the Agricultural Adjustment Act of 1938, as amended, which prohibits the granting of individual allotments in excess of cotton history for the previous 3 years.
3. Provision should be made for permitting increases in parish allotments without necessarily applying a uniform percentage distribution of such increase to both old and new farms but rather permitting a greater proportion of the increase to be allotted among new farms.
4. Provision should be made for granting limited discretionary powers to distinguish between bona fide new settlers who are actually establishing family-sized farms and those new settlers with faulty contracts who are merely in process of clearing land for resale by speculating landowners, when applying the flexible provisions under the first three recommendations.

Although this has not been an exhaustive study of the A.A.A. program as it relates to cotton production, it has been sufficiently detailed to indicate that certain changes in A.A.A. policy would partly alleviate the settlers' problems. Whether this will be done by a special program for this particular area or by a system whereby allotments are associated with the farmer rather than the farm or by some other method, must be left to the policy-making section of the A.A.A.

No attempt has been made in this study to deal with all the problems of new settlement but rather to point out and analyze those which appear most pressing. Therefore, the suggested programs and policies herein presented are in no sense complete or all-inclusive, nor do they necessarily represent final efforts with regard to the problems dealt with in this study. Instead, an attempt has been made to outline the major lines of action indicated as necessary for consideration by the county and area planning committees, local and state officials, and others empowered to deal with the problems involved.

In addition to the specific programs and policies proposed above, however, certain corollary programs are necessary. These will include: (1) negotiation with the land vendors for lower prices and more reasonable terms because all of the land cannot be purchased and resold, (2) farm debt adjustment, (3) immediate organization of county land-use planning committees, (4) intensive educational campaign, and (5) a plan to provide for legal assistance to the new settlers in checking title to the land they propose to buy.

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The Hot Water Treatment Of Sugarcane

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THE HOT WATER TREATMENT OF SUGARCANE

I. INTRODUCTION AND REVIEW OF INVESTIGATIONS CONCERNING HOT WATER TREATMENT OF SUGARCANE

C. W. Edgerton

Introduction

The investigations on the hot water treatment of sugarcane reported in this bulletin represent the work of various members of the Department of Plant Pathology of the Louisiana Agricultural Experiment Station and the Department of Botany of Louisiana State University with the assistance of several graduate students who were interested in sugarcane problems.

It has seemed advisable to concentrate upon these investigations. Soaking seed cane in hot water may not only become a useful control measure for the chlorotic streak disease but under some conditions may be useful in stimulating the growth of young cane.

The investigations are far from complete and should be continued. However, the information which has already been obtained should be of considerable interest and value to the sugar industry of the State.

Review of Investigations

The introduction of the chlorotic streak disease in Louisiana presented problems which required immediate investigation. One of the more important was to determine whether or not this disease could be controlled effectively and economically by treating the seed cane with hot water—a control measure that was at the time being used quite extensively in some of the tropical sugar countries. There was no assurance that this would be effective in Louisiana, owing to the fact that seed cane normally lies in the soil in a more or less inactive condition from planting time in the fall until spring. In the tropics the buds on the seed pieces germinate immediately and the stimulation brought about by the hot water treatment is desirable. In Louisiana there was a possibility at least under some conditions that stimulation of the shoots in the fall would be dangerous.

Preliminary investigations were started to determine, among other things, (1) whether or not the hot water treatment would eliminate the disease from the stalks; (2) the effect of different temperatures on the cane; (3) the reaction of the different varieties to the higher temperatures; and (4) the effect of the treatment on germination, stands, and yields. As the work advanced, other problems, including the effect of the treatment on the red rot disease, seemed of interest and had to receive some consideration. Finally, with the extra appropriation which was obtained, larger field tests were started. At the present time only a progress report is being made. It will require tests through several years to obtain accurate information upon which recommendations can be made.

A. Effect of Hot Water Treatment on the Chlorotic Streak

(SEE ARTICLE II)

In the tropics it has been found that treating the cane at 52° C. would eliminate the disease from the seed cane. It seemed important to duplicate some of this work in Louisiana. The results which have been obtained in Louisiana agree with those obtained in the tropics. The chlorotic streak disease seems to be entirely eliminated from seed cane by treating it for 20 to 30 minutes in hot water at 52° C.

B. Small Plot Tests at Baton Rouge

(SEE ARTICLE III)

Small plot tests have been conducted at Baton Rouge during two years in which different varieties were treated at different temperatures and planted at different times in the fall. From these tests the following conclusions, with reservations, seem of interest.

a) The hot water treatment is responsible for a more rapid germination of the buds immediately after planting. This means better stands in the fall.

b) In general the hot water treated cane gave satisfactory stands in the spring, though in a few cases involving green cane in August plantings the stands were not good.

c) Temperatures from 50° C. to 52° C. seemed to give the best results. More rapid growth was obtained and none of the varieties was injured at these temperatures.

d) Treating the cane at 45° C. did not seem to stimulate growth to any great extent.

e) Temperatures above 52° C. gave somewhat erratic results. In some cases the cane was treated as high as 56° C. without any serious injury while in other cases it was injured very severely. For the most satisfactory, consistent results, it would seem that temperatures above 52° C. should not be used.

C. Red Rot and the Hot Water Treatment

(SEE ARTICLE IV)

The red rot disease, which is frequently responsible for poor stands in cane fields, apparently also becomes a factor in the hot water treatment problem. While the evidence is still very incomplete, two important conclusions seem probable from the results which have been obtained and the observations which have been made:

1. Red rot spores which are on the stalks at planting time are apparently killed by treating the seed cane in hot water at 52° C. The mycelium in very young lesions also seems to lose its virulence during the treatment.

2. On the other hand, seed cane treated in hot water, at least under some conditions, becomes more susceptible to red rot and may be injured severely if infection follows the treatment. Whether this will have any economic importance is in doubt at present.

D. Biochemical Changes in Treated Cane

(SEE ARTICLE V)

The fact that treated cane becomes more susceptible to red rot suggests that certain chemical changes have resulted from the treatment. At present the data available give very little information as to the nature of these changes. These changes, however, are very interesting. If understood they might throw some light on the nature of resistance and susceptibility to disease. It is probable that host-parasite relationships will be studied very intensively in the years to come, and such chemical changes as these that have occurred in sugarcane suggest a promising line of approach.

E. Cooperative Tests

(SEE ARTICLE VI)

During the past year cooperative field tests were conducted on nine plantations in different parts of the sugar belt. These tests were replicated and were on a scale large enough to give accurate information on yield. The seed cane was treated with hot water at 52° C. and plantings were made in August, September, October, and November.

In the August plantings the plots planted with treated seed cane produced on the average slightly less than the plots planted with untreated seed cane. In the three later plantings, on the other hand, the plots planted with treated cane produced better. The increase in yields in the September and October plantings averaged nearly four tons per acre.

It is hoped that these cooperative tests can be continued through at least five years.

II. EFFECT OF HOT WATER TREATMENT ON THE CHLOROTIC STREAK

I. L. FORBES

In 1937 the chlorotic streak disease was found in Louisiana and since that date it has spread to all parts of the sugar belt. It was soon recognized that control measures might have to be taken and that in such an event a knowledge of the effect of the hot water treatment on the disease in the cane varieties grown in Louisiana would be invaluable. This paper reports the results of experiments designed to indicate the effects of the treatment on both diseased and healthy seed cane. The experiments were carried out in 1939 and 1940 at Montegut, Louisiana, in cooperation with Mr. Lee Shaffer, manager of one of the South Coast properties.

In 1939 two sets of tests were carried out, comprising an August planting and a September planting. The "standard" hot water treatment of 52° C. for 20 minutes was applied to both healthy and diseased stalks. Comparison lots of untreated canes were included. In the August planting the varieties C.P. 29-320 and C.P. 807 were used. In the September planting C.P. 28-19 was added. The results are given in Tables 1 and 2.

In 1940 a planting test was carried out with the varieties C.P. 28-19 and C.P. 29-320. The seed cane was treated at 52° C. for 30 minutes. Comparison lots of untreated canes were included. The results are given in Table 3.

It may be noted from the tabulated results that the hot water treatments gave a very satisfactory control of the chlorotic streak disease. The treatments also gave an appreciable increase in germination and in the rate of growth of both diseased and healthy cane.

TABLE 1. Hot Water Treatment for the Control of Chlorotic Streak.
Montegut, La. Planted August 2, 1939.

Variety	Treatment	Number Eyes Planted	Stand Count, 11/6/39	Per Cent Plants Diseased	
				11/6/39	9/12/40
C.P. 807	Diseased, treated	188	120	0	0
C.P. 807	Diseased, not treated	188	115	3.47	31.1
C.P. 807	Healthy, treated	154	118	0	0
C.P. 807	Healthy, not treated	176	119	0	0
C.P. 29-320	Diseased, treated	131	118	0	0
C.P. 29-320	Diseased, not treated	141	102	4.9	97.7
C.P. 29-320	Healthy, treated	122	141	0	3.4
C.P. 29-320	Healthy, not treated	134	77	0	0

TABLE 2. Hot Water Treatment for the Control of Chlorotic Streak.
Montegut, La. Planted September 15, 1939.

Variety	Treatment	Number Eyes Planted	No. Eyes Germinated, 11/6/39	Per Cent Plants Diseased	
				11/6/39	9/12/40
C.P. 28-19	Healthy, treated	315	150	0	0
C.P. 28-19	Healthy, not treated	298	89	0	0
C.P. 28-19	Diseased, treated	314	159	0	0
C.P. 28-19	Diseased, not treated	310	82	39.0	31.1
C.P. 29-320	Healthy, treated	372	201	0	1.28
C.P. 29-320	Healthy, not treated	361	144	0	0
C.P. 29-320	Diseased, treated	322	141	0	0
C.P. 29-320	Diseased, not treated	324	103	37.8	21.8
C.P. 807	Healthy, treated	368	116	0	0
C.P. 807	Healthy, not treated	313	93	0	0
C.P. 807	Diseased, treated	307	99	0	0
C.P. 807	Diseased, not treated	305	65	18.46	43.3

TABLE 3. HOT WATER TREATMENT FOR THE CONTROL OF CHLOLOTIC STREAK. MONTEGUT, LA. PLANTED SEPTEMBER 13, 1940.

VARIETY	TREATMENT	NUMBER EYES PLANTED	STAND COUNT, 11/8/40	PER CENT PLANTS DISEASED		
				11/8/40	4/24/41	5/15/41
C.P. 28-19.....	Diseased, treated	232	85	0	0	0
C.P. 28-19.....	Diseased, not treated ..	232	96	30.2	0	26.59
C.P. 28-19.....	Healthy, treated.......	232	96	0	0	0
C.P. 28-19.....	Healthy, not treated...	232	85	1.17	0	0
C.P. 29-320....	Diseased, treated	440	116	0	0	0
C.P. 29-320....	Diseased, not treated ..	440	108	17.6	0	31.25
C.P. 29-320....	Healthy, treated.......	440	130	0	0	0
C.P. 29-320....	Healthy, not treated...	440	114	1.76	0	0

III. SUMMARY OF RESULTS OBTAINED IN SMALL PLOT TESTS AT THE SUGAR STATION, BATON ROUGE*

C. W. EDGERTON, I. L. FORBES, AND P. J. MILLS

When it was determined that the chlorotic streak was spreading in Louisiana, it seemed essential to obtain information as rapidly as possible on the hot water treatment method of control. While this control measure had apparently been satisfactory in the tropics, there was no certainty that it would be of value in Louisiana. In Louisiana the seed cane is planted in the fall and then remains more or less inactive until spring. There was a possibility that following the hot water treatment there would be a too rapid growth of the cane shoots in the fall, or that the treatment would weaken the seed cane so that it would deteriorate during the winter months.

Before recommendations could be made or before large-scale field tests could be started, information on the following seemed necessary:

1. Would seed cane planted at different times in the fall react in the same way to the hot water treatment?

2. Would all the varieties which are being grown in Louisiana react in the same way to the hot water treatment?

3. At what temperature should the water in which the seed cane was soaked be heated?

It was believed that the desired information could be obtained most rapidly by treating seed cane of the different varieties at different temperatures and then planting this at various times in the fall of the year in small plots. Such plots were planted in the fall of 1939 and the fall of 1940, and from these information has been obtained which has helped to answer the above questions. As these plots were small—usually a single row about 25 feet in length—the yield data which have been obtained must be used with a great deal of caution.

In the 1939-1940 test each plot was a row 25 feet in length. In this was planted seed cane which had been treated for 30 minutes at 45° C.,

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* Much of the field work in this project was carried on by the following graduate students: C. S. Loh, K. H. Lei, and A. J. Benton.

52° C., and 56° C. Plantings using the six commercial varieties Co. 281, Co. 290, C.P. 28-11, C.P. 29-320, and C.P. 29-116 were made on September 27, October 18, and November 6. The weather conditions in the fall and winter were very satisfactory. The cane planted in September germinated immediately but in the October and November plantings there was practically no shoot development until spring. The treated cane in the September planting germinated more rapidly than the untreated cane and every treated plot had a better stand when killed by frost. The results of the test are summarized in Table 1.

TABLE 1. YIELD OF CANE OF SIX VARIETIES PLANTED AT VARIOUS DATES IN SMALL NON-REPLICATED PLOTS USING SEED CANE TREATED FOR 30 MINUTES AT DIFFERENT TEMPERATURES, 1939-40.

DATE OF PLANTING	TONS OF CANE PER ACRE			
	45° C.	52° C.	56° C.	Untreated
September	20.56	24.22	9.80	19.64
October	18.70	23.95	5.80	19.80
November	16.53	22.28	4.57	18.54
Average	18.60	23.48	6.72	19.33

In this test, treating the seed cane with water at 52° C. gave material increases in yields. However, as stated above, results of such a test must be used with much caution.

The test was repeated in 1940-41, using the twelve varieties Co. 281, Co. 290, C.P. 28-11, C.P. 28-19, C.P. 29-320, C.P. 29-116, C.P. 34-120, C.P. 34-79, C.P. 29-120, C.P. 33-243, C.P. 31-529, and C.P. 29-103. Seed cane was treated at 45°, 50°, 52°, 54°, and 56° C., and plantings were made in August, September, October, and November. Weather conditions were not as favorable for good germination as in the preceding year and drainage conditions in some parts of the field were not good. The results of the test are summarized in Table 2.

TABLE 2. YIELD OF CANE OF TWELVE VARIETIES PLANTED AT VARIOUS DATES IN SMALL NON-REPLICATED PLOTS USING SEED CANE TREATED FOR 20 MINUTES AT DIFFERENT TEMPERATURES, 1940-41.

DATE OF PLANTING	TONS OF CANE PER ACRE					
	45°	50°	52°	54°	56°	Untreated
August	23.37	25.04	25.56	15.34	0.63	29.21
September	28.66	32.39	30.85	31.79	27.92	31.70
October	23.87	24.33	25.68	22.45	17.20	22.35
November	23.22	26.85	26.94	21.21	10.65	25.78
Average	24.78	27.15	27.26	22.69	14.10	27.26

This test seems to indicate that temperatures of 50° to 52° C. are the most satisfactory for seed treatment, though under some conditions higher temperatures may not be harmful.

Treating the green cane in August apparently resulted in some injury. The varieties reacted in much the same way. None was injured by a temperature of 52° C.

IV. RELATION OF THE HOT WATER TREATMENT OF SUGARCANE TO THE DEVELOPMENT OF RED ROT

I. L. Forbes

In the course of the study of the effects of the hot water treatment on sugarcane, some treated and untreated stalks were inoculated with the red rot fungus. These tests were repeated and in many cases it was observed that the treated cane appeared to be more seriously affected by the red rot than the untreated cane. These observations presented new problems in the hot water treatment investigations which seemed important for further consideration. It was quite evident that before any final recommendations in regard to the hot water treatment could be formulated some questions would have to be answered. For example, would the treatment with hot water make the stalks more susceptible to red rot? Would the hot water treatment destroy red rot infections that had become established in the stalks? Would the spores of the red rot fungus which were present on the seed cane at planting time be destroyed by the hot water? Preliminary tests bearing on these questions were begun immediately.

In a series of tests designed to study the effect of the hot water treatment on the resistance or susceptibility of the cane to subsequent infection by red rot, similar lots of treated and untreated cane were inoculated with red rot spore suspensions and planted. The varieties used in these tests were as follows: Co. 281, Co. 290, C.P. 28-11, C.P. 34-53, C.P. 31-962, C.P. 34-55, C.P. 34-75, C.P. 34-79, C.P. 34-120, and C.P. 33-243. These varieties represent all degrees of resistance and susceptibility comprised within the Louisiana canes as evidenced from inoculation tests. After three weeks the stalks were taken up, split, and examined. These studies of the treated and untreated canes revealed that without exception, in every one of the ten varieties used in the test, the red rot damage was apparently more extensive in the canes that had been given the hot water treatment.

Another series of tests was designed to study the effect of the hot water treatment on red rot infection present at the time of the treatment. Similar lots of cane were cut, inoculated with spore suspensions of the red rot fungus, and planted. At daily intervals thereafter certain lots were dug up, given the hot water treatment at 52° C. for 20 minutes, and then replanted. Three varieties were used in these tests: Co. 281, C.P. 28-11, and C.P. 33-243. One week after the last set of hot water treatments the canes were dug, split, and examined. No red rot was noted in any stalks of any variety given the hot water treatment within two days of the inoculation. Red rot lesions were present in stalks given the hot water treatment three, four, and five days after inoculation, but the lesions did not appear to be as well developed as in the lots inoculated at the same time but not treated with hot water. These results indicated that the mycelium of the red rot fungus in well-established lesions was not entirely destroyed by the heat treatment.

Another series of tests was designed to study the effect of the hot water treatment on the spores of the red rot fungus. Spore-suspensions were treated at 52° C. for 5, 10, and 20 minutes, respectively, following which these suspensions were used to inoculate cut canes. The canes were planted. After two weeks they were dug, split, and examined. No red rot developed in any of the canes inoculated with heated spores. The results appear to indicate that any red rot spores present at the time of the hot water treatment are destroyed.

It is recognized that these tests were of a distinctly preliminary nature and that the results will have to be substantiated by further tests before reliable conclusions can be drawn. The results, however, are of much interest, and further studies may help to explain some of the difficulties that have occurred in determining the resistance and susceptibility of cane varieties to the red rot.

V. BIOCHEMICAL ASPECTS OF THE HOT WATER TREATMENT OF SUGARCANE

JEAN DUFRENOY

It is a common observation that in diverse types of injury to sugarcane a red color develops. This red color is so noticeable in cane infected with the red rot fungus as to have given rise to the name "red rot."

Just as in the colorimetric determination of pH values solutions of certain chemicals take on characteristic colors, so with respect to oxygen, solutions of certain chemicals take on characteristic colors when oxygen respectively enters or leaves the molecular structures. Such indicator reagents have found increasing use in recent years in the study of biochemical problems in both plants and animals.

With respect to sugarcane it is therefore possible, by adding certain solutions, to test the nature of the process or processes involved in the formation of the red pigment in sugarcane. When sections of sugarcane tissue are immersed in certain solutions which become colored upon the addition of oxygen (e.g. ortho-diphenol, para-diphenol, catechol, adrenaline, etc.), the solutions become colored, indicating that the tissue releases oxygen which then unites with the chemical. In healthy cane this oxygen constitutes the normal supply made available for respiration, and the amount of such oxygen would depend upon the age of the tissue, the temperature, and other factors.

When the tissues of cane that had been given the hot water treatment at 52° C. for 20 minutes were immersed in the above indicator solutions, the solutions became colored at a more rapid rate, or became more deeply colored. These results possibly indicated that there was more available oxygen in the cells of sugarcane which had been treated at 52° C.

It has been shown from inoculation experiments reported elsewhere in this publication that the development of the red rot fungus and the production of the red pigment took place more rapidly in cane inoculated following hot water treatment than in untreated cane. It is possible that the development of the red pigment was an oxidation process. This was further tested by immersing reddened tissues of cane in solutions which not only receive but actively abstract oxygen. In such solutions the red color disappeared. The oxidation reactions were found to be reversible. The results suggested that the hot water treatment at 52° C. brought about some change which increased the oxygen supply, perhaps also increasing respiration. In cane not affected with red rot this increase in oxygen supply may well have contributed to the observed increased vigor of the cane. In cane affected with red rot the change may well have contributed to the observed increase in the growth of the fungus and the accompanying increase in pigmentation. There is a possibility that the increased vigor of the host was brought about at the expense of a decreased resistance to the fungus parasite.

When cane tissues that had been heated to 60° C. were immersed in the indicator solutions first mentioned, the solutions did not become colored. When such tissues were inoculated with the red rot fungus, there was growth of the fungus, but no development of red pigment. These results appeared to indicate that the ability of the cane tissue to accept, hold, and give up oxygen was destroyed at 60° C.; and further, that the oxidation resulting in the red pigment did not take place in cells treated at 60° C.

It has long been recognized from innumerable inoculation experiments with standing cane and with cut cane that something happened incident to the cutting of the cane that renders it much more susceptible to the attack of the red rot fungus and enhances the development of the red pigment. Obviously such effects are comparable with the effects attending the hot water treatment. What happens, moreover, may well be of such deep significance as to relate not only to the particular resistance of cane to red rot, but also to the chlorotic streak relationship and even to such matters as inversion and windrowing properties.

It is to be acknowledged, of course, that under field conditions the development of the red rot fungus in standing cane or in planted cane is probably far more complicated a matter than that of the available oxygen supply within the tissues. Other enzyme systems may be involved, particularly the dehydrogenase system acting in a complementary manner to the oxygenase system. Yet it is of particular interest at this time to note that the hot water treatment of cane at 52° C. for 20 minutes appears to have opened up new approaches to old problems. These approaches in turn appear to afford unusual opportunities for the further study of many fundamental problems intimately associated with the continued progress of sugarcane production in Louisiana.

VI. REPORT ON COOPERATIVE TESTS WITH THE HOT WATER TREATMENT OF SUGARCANE

W. J. Luke

Introduction

The rapid spread of chlorotic streak disease throughout the sugarcane belt in 1938 and 1939 made it imperative that information be obtained on possible means of controlling chlorotic streak. When the seriousness of the situation in Louisiana was realized by the American Sugar Cane League, an appropriation was made for the purpose of conducting research in this field. R. T. Gibbens, Jr., of the Louisiana Agricultural Experiment Station, was selected to carry on the work with the advice of members of the American Sugar Cane League, the Louisiana Agricultural Experiment Station, and the Division of Sugar Plant Investigations of the United States Department of Agriculture. He laid out and planted the plots in 1940 and obtained stand counts during the fall. In February, 1941, he resigned, and since that date the writer has carried on the work.

The purpose of investigation was to determine the effect on stands and yields resulting from the application of the hot water treatment of seed cane. The investigation involved tests with different varieties at different dates of planting and on different soil types. This paper contains the results of the first year's work and also some germination studies on the 1941 planting. With very few exceptions seed cane not affected with the chlorotic streak disease was used.

The cooperation of the following plantations was obtained by the American Sugar Cane League for the purpose of carrying on this work:

Cooperator	Plantation	Varieties
Est. Harry L. Lawes	Cinclare	C.P. 29-320, Co. 281
Bronier Thibaut	Glenwood	C.P. 29-320, C.P. 28-19
Realty Operators, Inc.	Greenwood	C.P. 29-320, C.P. 28-19
South Coast Co.	Terrebonne	C.P. 29-320, C.P. 28-19
Godchaux Sugars, Inc.	Raceland	C.P. 29-320, C.P. 28-19
Meeker Sugar Refining Co.	Meeker	C.P. 29-320, C.P. 28-19
Milliken and Farwell	Westover	C.P. 29-320, C.P. 28-19
Delgado-Albania Plantation	Albania	C.P. 29-320, Co. 290
Billeaud Sugar Factory	Billeaud	C.P. 29-320, Co. 290

Experimental Methods

The plots used in the tests were mostly 1/80-acre in size. The treatments were randomized, an arrangement which greatly increased the reliability of the comparisons by minimizing the differences due to such factors as soil, fertility, and drainage. Four replications were made of both check and treated cane of both varieties at each planting.

The variety C.P. 29-320 was selected for planting on all the plantations. The variety C.P. 28-19 was used in six localities, the variety Co. 290 in two localities, and the variety Co. 281 in one locality. The supplementary varieties which were selected represented the ones most widely grown in the respective localities.

The plantings were made as near the first of August, September, October, and November as possible. With the exception of some plantings at Billeaud, all the plantings were composed of 4 untreated and 4 treated plots of each variety. The treatment consisted of soaking the cane in water at 52° C. for 20 minutes.

The treating procedures as a whole were similar on all plantations. Tanks were used for the hot water treatment, each tank being approximately 6 by 4 by 10 feet in size, with steam jets at each end. The steam was furnished either by locomotives or sugarhouse boilers. An electric, gas, or steam pump kept the water in circulation during the treating process. The cane to be treated was placed in iron and screen baskets and placed in the tanks by means of the regular hoists used in unloading cane. In all plots two running stalks were planted with a lap of 12 to 18 inches.

The land was in the regular plantation rotation—two years in cane alternating with a cover crop of soybeans with or without corn. The cover crop was turned under in July and allowed to decompose before the first planting. The cane was covered with 3 to 5 inches of soil by means of disc cultivators or turning plows. All cultivation was done in the regular plantation fashion. None of the plots received anything in the way of special treatment. This procedure was followed with the plant cane of both 1940 and 1941.

Germination counts were made in the fall on all the plots. Stand counts were made in the spring and included suckers as well as main stalks. Any special condition which may have arisen during the year is discussed in conjunction with the results obtained on the particular plantation.

The plots were harvested and weighed separately. With the exception of the plots at Meeker, the cane was weighed the day it was cut. In order to obtain the full tonnage and to keep the weights for the different plantations comparable, it was necessary in most instances to sacrifice sucrose for tonnage. An attempt was made on all plantations to keep the knives as high and low as possible. The cane was stripped clean in all cases and the weights in the tables represent clean cane cut from the ground to the "white joint." Each plot was weighed in the field by means of a portable dial-scale weighing apparatus.

The chemical analyses were made by the chemists of the various plantations, with the exception of Cinclare. The Cinclare samples were run at the University by the Experiment Station chemist. The analyses were made from five-stalk samples from each plot, and the values shown in the yield tables are averages of four such samples unless otherwise indicated. The total sugar was computed from the following formula, recommended by Deerr:

$$\frac{\text{Purity of juice} - \text{Purity of molasses}}{100 - \text{Purity of molasses}} = \text{(Factor)}$$

$$\frac{\text{(Factor)} \text{ x lbs. solid in juice}}{96^\circ} = \text{Sugar per ton.}$$

The following factors were used arbitrarily in the above formula:

1. Boiler house efficiency = 100
2. Purity of molasses = 30
3. Extraction = 75

While it is recognized that the use of these assumed values must involve some errors, the degree and frequency of these errors are essentially the same in all.

TABLE 1. EFFECT OF THE HOT WATER TREATMENT ON THE GERMINATION OF SEED CANE AS REVEALED BY STAND COUNTS

	TOTAL NUMBER OF PLANTS*			
	C.P. 29-320		C.P. 28-19	
DATE OF COUNT	Tr.	Check	Tr.	Check
Greenwood Plantation, Thibodaux. Planted October 1, 1940				
October 24, 1940	14	3	102	4
December 9, 1940	338	161	837	345
Godchaux Plantation, Raceland. Planted October 2, 1940				
October 30, 1940	126	37	427	70
December 12, 1940	486	314	582	497
Glenwood Plantation, Napoleonville. Planted September 30, 1940				
October 28, 1940	105	16	245	14
December 9, 1940	356	274	516	255
Westover Plantation, Port Allen. Planted October 7, 1940				
October 28, 1940	0	0	0	0
December 10, 1940	455	302	659	388
Meeker Plantation, Meeker. Planted October 8, 1940				
October 28, 1940	0	0	0	0
December 17, 1940	435	135	898	493
Terrebonne Plantation, Montegut. Planted October 9, 1940				
October 28, 1940	0	0	0	0
December 12, 1940	78	45	139	23
Albania Plantation, Jeanerette. Planted October 4, 1940				
October 31, 1940	0	0	0	0
December 18, 1940	53	6	42	6
Billeaud Plantation, Broussard. Planted October 3, 1940				
October 31, 1940	3	0	129	14
December 18, 1940	320	151	724	622
Cinclare Plantation, Cinclare. Planted October 5, 1940				
	C.P. 29-320		Co. 281	
November 2, 1940	177	38	256	91
December 10, 1940	552	440	573	600

* Counts based on four 1/80-acre plots, except Billeaud test based on two 1/58-acre plots, but totals in this report converted to four 1/80-acre plots for comparisons.

The comparisons thus remain satisfactory from the statistical viewpoint. The experimental procedures as outlined in the foregoing paragraphs hold true for the various plantations as a whole from planting to harvesting. Any deviation from the general practice is mentioned in the report for that particular plantation. In order to obtain greater clarity in the results and insure fairness to each cooperating plantation involved, the results of the tests on each plantation have been handled separately.

Germination in Fall

In order to obtain precise information regarding the possible stimulation of cane by the hot water treatment—a stimulation reported as

TABLE 2. EFFECT OF THE HOT WATER TREATMENT ON THE SPRING STAND, 1940-1941

PLANTATION	DATE OF PLANTING, 1940	DATE OF COUNT, 1941	SPRING STAND COUNT FOR THE 1940 PLANT CANE							
			C.P. 29-320		C.P. 28-19		Co. 290		Co. 281	
			Ck	Tr	Ck	Tr	Ck	Tr	Ck	Tr
Raceland	Aug. 15	April 24	726	886	607	732				
	Aug. 30		812	1371	390	875				
	Oct. 2		715	998	597	685				
	Oct. 30		334	697	525	738				
Greenwood	Aug. 15	April 24	431	18	428	282				
	Aug. 29		874	1155	295	1550				
	Oct. 1		411	667	568	1080				
	Oct. 29		449	804	706	1128				
Glenwood	Aug. 14	April 24	481	349	674	677				
	Sept. 2		751	835	713	983				
	Sept. 30		422	552	490	582				
	Oct. 28		433	688	448	595				
Westover	Aug. 21	April 25	792	803	730	545				
	Sept. 6		869	1120	712	856				
	Oct. 7		547	651	657	741				
	Nov. 3		331	456	454	508				
Meeker	Aug. 23	April 23	410	327	486	242				
	Sept. 9		171	576	499	502				
	Oct. 8		303	545	678	749				
	Nov. 5		31	101	181	403				
Montegut	Aug. 26	April 24	194	182	400	433				
	Sept. 11		393	624	591	844				
	Oct. 7		231	358	462	619				
	Oct. 8		353	378	519	516				
Billeaud	Aug. 19	April 23	380	463			541	551		
	Sept. 3		443	808			738	1006		
	Oct. 3		348	776			745	857		
	Oct. 31		218	584			555	481		
Albania	Aug. 16	April 23	345	426			383	485		
	Sept. 4		507	856			840	858		
	Oct. 3		105	327			120	297		
	Oct. 31		465	716			505	668		
Cinclare	Aug. 21	April 24	935	948					331	144
	Sept. 5		909	1196					424	661
	Oct. 5		770	885					702	710
	Nov. 2		342	490					454	457

obtained in other regions—records were made of the numbers of shoots developing on the various field plots. A representative set of these records has been brought together in Table 1. Not only did more of the eyes on the treated cane germinate in the fall, but the germination was more rapid.

Stands in the Spring

The results given in Table 1 clearly indicated that the hot water treatment stimulated the germination of the buds. This, however, did not necessarily mean that the stands in the spring would be proportionately better. To determine this, stand counts were again made in April. The results of this count are shown in Table 2. It will be observed that in most cases the plots planted with treated cane had better stands in the spring than did the plots planted with untreated cane.

Test Field Results

The results obtained from the test plots on the nine cooperating plantations are given in Tables 3-11. While the tests were replicated, a few conditions developed which should be mentioned. These may help to explain some of the results which were obtained.

During August, 1940, when the first test plots were planted, the seed cane was in many cases very short and immature. In some of the plots it appeared as if this immature cane was injured by the hot water treatment.

At Cinclare considerable rotting of the seed pieces of the variety Co. 281 was observed.

At Albania the October test in particular was unsatisfactory. Apparently the cane suffered from drought, as may be concluded from the fact that only 0.32 inches of rain fell between September 4 and October 26. The seed cane in the October planting suffered severely from the so-called "dry rot."

In the November test on Billeaud Plantation the rather low yields obtained with Co. 290 in the treated plots of the November planting may be attributed to the dry rot resulting from surface erosion on two rows of one of the plots.

On Westover Plantation, with one exception, the yields on all the plots were exceptionally high. Evidently growth conditions were very favorable for both the treated and the untreated cane.

At Greenwood during seven days following the planting, 13.43 inches of rain were recorded. A particularly heavy rain fell the day after planting and so packed the soil that the young shoots were unable to penetrate to the surface.

At Meeker a slight infection of chlorotic streak developed in the untreated plots of the November planting. As a protection to the owner, the diseased cane was rogued out. This is largely responsible for the low yield recorded in the untreated plots.

TABLE 3. EFFECT OF THE HOT WATER TREATMENT ON TONNAGE AND SUGAR AT CINCLARE PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 29-320	Check	18.50	15.29	82.6	29.67		217.20	3.22
	C.P. 29-320	Treated	18.14	15.49	84.2	27.32	−2.35	219.47	2.99
	Co. 281	Check	17.10	14.26	83.4	13.91		203.84	1.41
	Co. 281	Treated	16.50	13.36	80.9	5.64	−8.27	187.46	0.52
September	C.P. 29-320	Check	17.70	14.58	82.2	33.98		206.23	3.50
	C.P. 29-320	Treated	18.35	15.29	83.1	34.88	+0.90	217.50	3.79
	Co. 281	Check	16.68	13.77	82.6	24.08		195.83	2.35
	Co. 281	Treated	17.00	14.06	82.7	27.42	+3.34	196.07	2.68
October	C.P. 29-320	Check	17.85	14.62	82.0	36.61		207.20	3.79
	C.P. 29-320	Treated	17.72	14.29	80.6	38.97	+2.36	200.15	3.89
	Co. 281	Check	16.13	12.60	78.1	31.72		173.17	2.74
	Co. 281	Treated	16.53	13.10	79.2	31.69	−0.03	181.55	2.87
November	C.P. 29-320	Check	17.98	15.04	83.6	37.56		215.11	4.03
	C.P. 29-320	Treated	17.95	14.81	82.5	30.78	−6.78	210.35	3.23
	Co. 281	Check	16.43	13.18	80.1	35.70		183.73	3.27
	Co. 281	Treated	15.93	12.61	79.1	31.43	−4.27	174.58	2.74

TABLE 4. EFFECT OF THE HOT WATER TREATMENT ON TONNAGE AND SUGAR AT ALBANIA PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	Co. 290	Check	16.27	13.38	82.21	16.78		174.08	1.46
	Co. 290	Treated	16.01	12.68	79.19	14.74	−2.04	175.78	1.29
	C.P. 29-320	Check	17.65	14.87	82.24	12.16		205.79	1.25
	C.P. 29-320	Treated	17.51	14.74	82.20	16.43	+4.27	204.02	1.67
September	Co. 290	Check	15.99	12.78	79.95	24.64		178.29	2.19
	Co. 290	Treated	16.32	13.15	80.60	23.75	−0.89	185.05	2.19
	C.P. 29-320	Check	17.25	14.45	83.77	17.38		207.03	1.79
	C.P. 29-320	Treated	17.53	14.72	83.98	20.32	+2.94	211.21	2.14
October	Co. 290	Check	15.94	12.99	81.43	9.42		182.99	0.86
	Co. 290	Treated	15.80	12.89	81.54	12.68	+3.26	181.77	1.15
	C.P. 29-320	Check	12.27	14.53	83.95	7.78		147.76	0.57
	C.P. 29-320	Treated	17.34	14.50	83.57	13.63	+5.85	207.35	1.41
November	Co. 290	Check	16.42	13.48	81.99	23.70		190.55	2.25
	Co. 290	Treated	15.82	12.74	80.48	29.80	+6.10	178.25	2.65
	C.P. 29-320	Check	17.77	15.11	85.01	18.05		218.21	1.96
	C.P. 29-320	Treated	17.46	14.71	84.25	19.77	+1.72	211.43	2.08

TABLE 5. EFFECT OF THE HOT WATER TREATMENT ON TONNAGE AND SUGAR AT BILLEAUD PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 29-320	Check	16.70	13.37	79.12	17.55		183.10	1.60
	C.P. 29-320	Treated	17.29	13.69	79.17	22.44	+4.89	189.76	2.12
	Co. 290	Check	14.85	10.51	70.77	29.20		135.14	1.97
	Co. 290	Treated	14.38	10.26	70.12	32.47	+3.27	128.77	2.09
September	C.P. 29-320	Check	17.14	13.49	78.65	19.65		186.13	1.82
	C.P. 29-320	Treated	17.23	13.58	78.75	23.82	+4.17	187.48	2.23
	Co. 290	Check	14.85	10.63	71.55	33.13		137.73	2.28
	Co. 290	Treated	14.87	10.65	71.62	34.63	+1.50	138.15	2.39
October	C.P. 29-320	Check	17.02	13.36	78.46	21.34		184.11	1.96
	C.P. 29-320	Treated	17.60	13.72	77.90	27.07	+5.73	188.18	2.54
	Co. 290	Check	14.24	10.09	69.66	35.74		126.07	2.25
	Co. 290	Treated	14.77	10.57	71.53	36.40	+0.66	136.92	2.49
November	C.P. 29-320	Check	17.02	13.07	76.78	20.02		177.73	1.77
	C.P. 29-320	Treated	17.02	13.27	77.98	27.04	+7.02	182.27	2.46
	Co. 290	Check	14.48	10.24	70.69	37.09		131.52	2.43
	Co. 290	Treated	14.48	10.14	69.99	35.41	−1.68	129.26	2.28

TABLE 6. EFFECT OF THE HOT WATER TREATMENT ON TONNAGE AND SUGAR AT WESTOVER PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 28-19	Check	17.86	14.58	81.64	32.16		233.77	3.75
	C.P. 28-19	Treated	17.27	13.94	80.73	24.74	−7.42	195.56	2.41
	C.P. 29-320	Check	16.24	12.60	77.55	30.92		172.35	2.66
	C.P. 29-320	Treated	15.95	12.21	76.51	30.94	+0.02	165.58	2.56
September	C.P. 28-19	Check	17.87	14.65	81.90	33.98		207.00	3.51
	C.P. 28-19	Treated	17.45	14.25	81.61	33.12	−0.86	201.03	3.32
	C.P. 29-320	Check	15.98	12.17	76.14	34.23		164.57	2.81
	C.P. 29-320	Treated	15.92	12.14	77.32	37.27	+3.04	168.16	3.13
October	C.P. 28-19	Check	15.25	14.38	80.87	37.86		173.16	3.27
	C.P. 28-19	Treated	17.88	14.58	81.59	37.07	−0.79	205.90	3.81
	C.P. 29-320	Check	15.90	12.21	76.78	39.02		166.03	3.23
	C.P. 29-320	Treated	15.69	11.79	74.98	38.80	−0.22	157.54	3.05
November	C.P. 28-19	Check	17.35	14.05	81.02	35.66		197.60	3.52
	C.P. 28-19	Treated	17.66	14.22	80.53	34.20	−1.46	199.20	3.40
	C.P. 29-320	Check	16.03	12.35	76.52	33.00		166.46	2.74
	C.P. 29-320	Treated	15.91	12.24	76.91	38.55	+5.55	166.58	3.21

TABLE 7. EFFECT OF THE HOT WATER TREATMENT ON TONNAGE AND SUGAR AT RACELAND PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 28-19	Check	15.96	12.27	76.77	26.00		166.61	2.16
	C.P. 28-19	Treated	17.08*	13.06	76.54	26.99	+0.99	177.45	2.39
	C.P. 29-320	Check	16.64*	13.08	78.59	24.61		180.47	2.22
	C.P. 29-320	Treated	15.67	11.98	76.44	27.84	+3.23	162.43	2.26
September	C.P. 28-19	Check	15.48	11.83	76.40	21.79		160.34	1.74
	C.P. 28-19	Treated	16.30	12.74	78.06	28.61	+6.82	174.87	2.50
	C.P. 29-320	Check	16.40	12.79	78.25	28.10		176.63	2.48
	C.P. 29-320	Treated	16.15	12.55	77.65	33.26	+5.16	171.77	2.85
October	C.P. 28-19	Check	16.20	12.58	77.52	24.63		171.85	2.11
	C.P. 28-19	Treated	16.08	12.51	77.66	24.10	−0.53	171.08	2.06
	C.P. 29-320	Check	15.65	11.79	75.28	27.82		158.19	2.20
	C.P. 29-320	Treated	15.36	11.66	75.84	32.01	+4.19	157.18	2.51
November	C.P. 28-19	Check	16.76	12.76	76.19	28.03		172.81	2.42
	C.P. 28-19	Treated	15.48*	11.90	76.78	35.56	+7.53	161.65	2.87
	C.P. 29-320	Check	15.03*	11.23	74.73	28.09		150.07	2.10
	C.P. 29-320	Treated	14.97	11.42	75.75	30.30	+2.21	152.88	2.31

* One replication in each of these plots had to be discarded because of an error in cutting plots.

TABLE 8. EFFECT OF THE HOT WATER TREATMENT ON TONNAGE AND SUGAR AT MONTEGUT PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 28-19	Check	18.57	15.64	84.16	22.84		224.49	2.56
	C.P. 28-19	Treated	17.85	15.80	84.93	22.75	−0.09	218.86	2.48
	C.P. 29-320	Check	16.54	13.41	81.04	17.95		188.43	1.69
	C.P. 29-320	Treated	17.20	13.44	80.87	13.82	−4.13	195.54	1.35
September	C.P. 28-19	Check	18.77	16.01	85.26	24.34		231.52	2.81
	C.P. 28-19	Treated	19.02	16.29	85.63	26.28	+1.94	236.18	3.10
	C.P. 29-320	Check	16.66	13.50	79.55	27.28		184.28	2.51
	C.P. 29-320	Treated	16.75	13.65	81.50	28.48	+1.20	192.55	2.74
October	C.P. 28-19	Check	18.63	15.60	83.76	20.80		223.56	2.32
	C.P. 28-19	Treated	17.85	14.93	83.61	25.08	+4.28	213.61	2.67
	C.P. 29-320	Check	16.59	13.50	81.35	20.24		190.16	1.92
	C.P. 29-320	Treated	16.85	13.83	82.00	25.21	+4.97	195.59	2.46
November	C.P. 28-19	Check	18.65	15.78	84.62	26.11		227.38	2.96
	C.P. 28-19	Treated	18.34	15.29	83.36	24.38	−1.73	218.45	2.66
	C.P. 29-320	Check	16.57	13.28	80.12	28.28		185.38	2.62
	C.P. 29-320	Treated	17.15	14.05	81.93	27.23	−1.05	198.81	2.70

TABLE 9. EFFECT OF HOT WATER TREATMENT ON TONNAGE AND SUGAR AT GLENWOOD PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE*	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 28-19	Check	17.47	14.74	84.40	25.63		212.12	2.71
	C.P. 28-19	Treated	17.31	15.53	89.72	26.82	+1.19	230.74	3.09
	C.P. 29-320	Check	15.95	13.28	83.22	21.82		189.48	2.06
	C.P. 29-320	Treated	16.22	13.76	84.87	19.53	−2.29	198.67	1.94
September	C.P. 28-19	Check	17.86	15.76	88.27	25.44		232.29	2.95
	C.P. 28-19	Treated	17.06	14.79	86.69	29.16	+3.72	215.89	3.14
	C.P. 29-320	Check	16.34	13.87	84.86	25.56		200.09	2.55
	C.P. 29-320	Treated	16.14	13.54	83.87	27.57	+2.01	194.08	2.67
October	C.P. 28-19	Check	17.77	15.08	87.59	30.79		228.43	3.51
	C.P. 28-19	Treated	17.75	15.62	88.01	27.92	−2.87	229.83	3.20
	C.P. 29-320	Check	16.41	13.94	84.95	24.63		201.28	2.47
	C.P. 29-320	Treated	16.56	14.19	85.57	27.22	+2.59	205.42	2.79
November	C.P. 28-19	Check				27.11			
	C.P. 28-19	Treated				28.33	+1.22		
	C.P. 29-320	Check	16.18	13.54	83.52	25.22		193.30	2.43
	C.P. 29-320	Treated	16.10	13.98	86.90	30.58	+5.36	204.50	3.12

* Sucrose determination not accurate owing to the fact that the juice was obtained from an old type mill not particularly suited for high-fiber canes.

TABLE 10. EFFECT OF HOT WATER TREATMENT ON TONNAGE AND SUGAR AT GREENWOOD PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR Lbs. Per Ton	YIELD IN SUGAR Tons Per Acre
August	C.P. 28-19	Check	17.70	14.94	84.37	18.44		214.81	1.98
	C.P. 28-19	Treated	17.10	14.04	82.01	13.89	−4.55	198.52	1.38
	C.P. 29-320	Check	17.39	14.29	82.21	18.99		202.68	1.92
	C.P. 29-320	Treated	16.63	13.45*	80.85	1.36†	−17.63	188.75	0.12
September	C.P. 28-19	Check	17.39	14.62	82.02	18.11		201.91	1.82
	C.P. 28-19	Treated	18.65	15.95	85.49	32.42	+14.31	231.00	3.74
	C.P. 29-320	Check	17.20	14.45	82.09	27.63		199.98	2.76
	C.P. 29-320	Treated	17.58	14.80	82.16	30.17	+2.54	204.67	3.08
October	C.P. 28-19	Check	17.55	14.80	84.25	30.47		212.52	3.23
	C.P. 28-19	Treated	17.77	14.91	83.83	34.86	+4.39	213.52	3.72
	C.P. 29-320	Check	17.39	14.45	83.05	33.35		205.94	3.43
	C.P. 29-320	Treated	17.20	13.67	79.51	34.22	+0.87	190.09	3.25
November	C.P. 28-19	Check	19.53	16.92	86.66	29.95		246.99	3.69
	C.P. 28-19	Treated	18.64	17.01	86.61	30.27	+0.32	235.53	3.56
	C.P. 29-320	Check	17.51	14.62	83.36	30.43		208.56	3.17
	C.P. 29-320	Treated	17.27	14.34	83.02	36.15	+5.72	204.38	3.69

* Average of two plots.

† Only 8 pounds of cane in plot 2 and none in plot 3.

TABLE 11. EFFECT OF HOT WATER TREATMENT ON TONNAGE AND SUGAR AT MEEKER PLANTATION, 1940-41.

DATE OF PLANTING	VARIETY	TREATMENT	BRIX	SUCROSE	PURITY	TONS PER ACRE	DIFFERENCES	YIELD IN SUGAR	
								Lbs. Per Ton	Tons Per Acre
August	C.P. 28-19	Check	15.23	11.66	77.24	33.73		160.63	2.70
	C.P. 28-19	Treated	14.93	11.43	76.24	25.48	−8.25	154.11	1.96
	C.P. 29-320	Check	15.39	12.12	78.76	28.87		167.62	2.41
	C.P. 29-320	Treated	15.12	11.71	77.47	26.57	−2.30	160.31	2.12
September	C.P. 28-19	Check	14.44	11.07	76.44	32.91		149.68	2.46
	C.P. 28-19	Treated	15.67	12.31	78.29	34.28	+1.37	168.92	2.89
	C.P. 29-320	Check	15.35	11.89	77.36	20.52		162.28	1.66
	C.P. 29-320	Treated	15.19	11.68	76.95	33.74	+13.22	159.19	2.68
October	C.P. 28-19	Check	14.82	11.53	77.71	33.16		157.83	2.61
	C.P. 28-19	Treated	15.00	11.80	77.34	34.53	+1.37	158.51	2.73
	C.P. 29-320	Check	15.81	12.21	77.35	30.36		167.09	2.53
	C.P. 29-320	Treated	15.65	11.96	76.42	37.36	+7.00	162.15	3.02
November	C.P. 28-19	Check	15.00	11.49	76.52	22.66*		155.75	1.76
	C.P. 28-19	Treated	14.74	11.32	76.67	33.06	+10.40	153.55	2.53
	C.P. 29-320	Check	15.30	11.97	78.24	10.68		164.74	0.88
	C.P. 29-320	Treated	15.48	12.25	79.14	17.72	+7.04	169.80	1.50

* Total of 153 stalks and suckers, or 13.54 per cent of total, removed because of chlorotic streak infection.

Evaluation of Tests

It is to be recognized that the results which have been obtained cannot be considered as conclusive. The tests involved small areas, different soils, different environmental factors, and have been conducted for only one year. It is possible, and perhaps probable, that results in another year with different temperature and rainfall conditions might vary considerably from those obtained in 1940-1941.

It may be useful however to evaluate the results which have thus far been obtained and to form some idea of what might have been gained or lost in 1941 by treating seed cane with hot water.

The variety C.P. 29-320 was included in all the nine test fields and it is perhaps possible to judge how the hot water treatment affected this variety. In Table 12 there is presented a summation of the results obtained in 1940-1941 with C.P. 29-320.

It will be observed that in the August tests there was a slight decrease in yield in the plots planted with seed cane treated with hot water. This decrease, however, was largely due to the almost complete failure of the hot water treated plot at Greenwood.

In the other plantings very definite increases in yield were obtained in the treated plots: 3.9 tons per acre in the September plantings; 3.7 tons in the October plantings; and 3.0 tons in the November plantings. These increases are very significant. It is important to know whether such results would be obtained year in and year out.

TABLE 12. SUMMATION OF THE EFFECT OF THE HOT WATER TREATMENT ON TONNAGE, 1940-41 (VARIETY C.P. 29-320). YIELDS IN TONS PER ACRE.

	August Planting		September Planting		October Planting		November Planting	
PLANTATION	Treated	Check	Treated	Check	Treated	Check	Treated	Check
Cinclare	27.32	29.67	34.98	33.98	38.97	36.61	30.78	37.56
Billeaud	22.44	17.55	23.82	19.65	27.07	21.34	27.04	20.02
Albania	16.43	12.16	20.32	17.38	13.63	7.78	19.77	18.05
Westover	30.94	30.92	37.27	34.23	38.80	39.02	38.55	33.00
Raceland	27.84	24.16	33.26	28.10	32.01	27.82	30.30	28.09
Meeker	26.57	28.87	33.74	20.52	37.36	30.36	17.72	10.68
Glenwood	19.53	21.82	27.57	25.56	27.22	24.63	30.58	25.22
Greenwood	1.36	18.99	30.17	27.63	34.22	33.35	36.15	30.43
Montegut	13.82	17.95	28.48	27.28	25.21	20.24	27.23	28.28
Average	20.69	22.45	29.95	26.04	30.50	26.79	28.68	25.70

Tests in 1941-1942

Tests similar to those conducted in 1940-1941 are also in progress for harvest in the fall of 1942. On all the plantations cooperating in 1941, plantings were made in August, September, October, and November. Counts of germination were made on appropriate dates. Weather conditions were more satisfactory in the fall of 1941 than in 1940 and the germination in general was more satisfactory. Germination counts are given in Table 13. It will be observed that in most cases the hot water treatment stimulated the germination of the eyes.

TABLE 13. Effect of Hot Water Treatment on Germination, 1941-1942

Plantation	Date of Planting, 1941	Date of Count, 1941	Germination Counts									
			C.P. 29-320		C.P. 28-19		C.P. 29-116		Co. 290		Co. 281	
			Ck	Tr	Ck	Tr	Ck	Tr	Ck	Tr	Ck	Tr
Raceland	August 5	September 5	543	511	419	401						
	September 5	October 10	711	724	807	873						
	October 13	December 5	23	87	5	33						
Greenwood	August 12	September 30	694	587	716	790						
	September 9	September 30	157	481	120	549						
	October 1	December 5	362	490	544	723						
Glenwood	August 20	October 16	394	417	554	426						
	October 13	October 10	269	626	581	748						
	October 29	December 5	168	357	84	442						
Westover	August 12	October 10	694	775	498	703						
	September 13	October 10	179	289	73	286						
	October 14	December 7	60	145	50	281						
Meeker	August 19	October 7	162	187	248	265						
	September 12	October 7	135	236	176	364						
	October 8	December 6	119	307	203	417						
Montegut	August 11	September 10	578	503	467	364						
	September 10	October 9	259	435	195	429						
	October 9	December 5	203	398	186	494						
Billeaud	August 27	October 7	491	556			548	761				
	September 19	October 7	13	65			95	220				
	October 7	December 6	310	522			542	540				
Albania	August 19	October 6	280	312					647	639		
	September 18	October 6	70	489					100	682		
	October 6	December 6	145	520					259	444		
Cinclare	August 15	October 10	725	692							599	610
	September 6	September 29	402	400							284	464
	September 29	December 5	354	501							259	444

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State Tax Collections and Allocations, By Parishes, 1938, Louisiana

By

BUEFORD M. GILE, CHARLES ARNY AND HIRAM V. LOTT

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STATE TAX COLLECTIONS AND ALLOCATIONS, BY PARISHES, 1938, LOUISIANA

By

Bueford M. Gile, Charles Arny and Hiram V. Lott[1]

Introduction

The authors are not attempting here to explore the whole field of policy in financing state activities in Louisiana, although the data presented throw light on some of the considerations involved in such an undertaking. This report specifically calls attention to frequently neglected matters lying beyond the giving of special aids to equalize opportunity and promote the public welfare. It should serve to stimulate a wider public interest in the difficult problem of alleviating and preventing those maladjustments between people and natural resources which result in the need for one area permanently contributing to the support of another due to economic and political inefficiency. It also indicates certain phases of the taxation system in Louisiana which need further consideration. These matters have a new significance because of the rapidly growing impingement of revenues for national defense on the problem of supporting state institutions. The drift is in the direction of some states becoming as dependent on the federal government as some local units of government are now dependent upon the state for financial support.

This report contains data showing the approximate amount of taxes collected by the state of Louisiana in 1938, an estimate of the proportion of these revenues originating in each parish, and the amount of money paid by the state to the parishes for aids in the support of parish schools, health units, emergency relief, public welfare programs, and for homestead exemptions and other purposes authorized by law. The data on tax revenue collected in Louisiana during 1938 were obtained from the official record.

For 9 of the 31 taxes listed in Table 1, the record shows the amount collected from each parish, but for the other 22 taxes it was necessary to calculate the amount collected from each parish in order to obtain an estimation of the contributions of each parish to the total state revenue from taxes. The method used in the allocation of the revenue obtained from the 22 taxes among the 64 parishes is recorded in Appendix II.

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[1] Charles Arny and Hiram V. Lott were graduate students in the Department of Agricultural Economics, College of Agriculture, Louisiana State University, during 1939-40, and assisted in gathering the tax data as a part of their work in land economics.

Although the amount of tax collections by parishes has the unavoidable imperfection of estimation, the data are believed to be sufficiently accurate to justify the conclusions based on them.

State aid to local units of government in the United States has increased rapidly since 1900. At the same time, state and federal governments have expanded the sources of income through taxation. These larger units have an advantageous position in collecting taxes on retail sales, corporations, utilities, inheritances, etc. Those who believe that democracy in government is rather closely associated with decentralized control over expenditure of tax revenues have been insistent that a considerable part of the money collected by the state should be returned to local units for expenditure. This places the state in the position of a tax collection agency returning to the smaller units of government funds which were collected from them in the first place.

Although centralization in the collection of revenues does not necessarily imply centralization of expenditure, the individuals in units of government that collect taxes tend to increase their control over the selection and appointment of employees in whom and through whom the revenues collected are expended. Communities, on the other hand, try to obtain as large a share as possible of state and federal revenues for local expenditure, and there is a rather widespread feeling that these funds are collected from somebody else, and indeed in some cases they are.

Amount and Sources of State Tax Collections, 1938[2]

The state of Louisiana collected $65,088,505 in 1938 from 31 sources of tax revenue (Table 1). This expendable income represents at least 97 per cent of the total state revenue from taxes and licenses in 1938, other than the collections from the unemployment compensation tax. Other types of state income, such as borrowed money, rents and royalties, funds paid into the state treasury by the federal government, and interest on money loaned by the state, were not included in the tax income shown above, since this study is concerned primarily with income derived from taxes levied by the state.

The largest amount of revenue in 1938 was obtained from the gasoline gallonage sales tax, which produced a total of $16,548,380, or about 25 per cent of the total tax income. Other important sources of tax revenue were the severance tax, the general property tax, the income tax, the motor vehicle tax, the public welfare tax (sales tax) and the tobacco tax. The seven taxes enumerated above produced 83 per cent of the total receipts from the 31 different taxes listed in Table 1. Only two other taxes, the alcohol beverage tax and the insurance license tax, produced as much as a million dollars of income. The gasoline tax produced nearly two times as much revenue as the general property tax, and the severance tax exceeded it by a million and a quarter dollars.

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[2] Jesse H. Bankston, Head, Tax Research Section, Department of Revenue, State of Louisiana, assisted in checking the data in this and the two following sections. Sam R. Carter, Head, Bureau of Research, Department of Public Welfare, checked the data on expenditures for public welfare.

The severance tax ranked second in the amount of revenue collected by the state in 1938 from various taxes. A large part of the severance tax income is obtained in connection with the removal of oil. The people of Louisiana and other southern oil producing states may well consider whether all of the income from the severance of nonreproducible resources should be spent now, or whether part of it should be accumulated for use when these resources approach exhaustion. If all of the present

TABLE 1. THE MAIN SOURCES OF TAX INCOME AND AMOUNT COLLECTED, LOUISIANA, 1938
(Unemployment compensation tax, borrowed money, interest on investments, rents and royalties, federal aid and miscellaneous fees not included)

NAME OF TAX, LICENSE OR FEE	Amount collected	Footnote Reference	
	Dollars	*Number*	*Page*
1. Gasoline tax	16,548,380	1	18
2. Lubricating oil tax	785,525	1	20
3. Severance tax (oil, gas, timber, salt, etc.)	10,000,440	1	43
4. General property tax (published total corrected)	8,617,761	2	49
5. Income tax	5,439,476	1	35
6. Motor vehicle tax	4,789,255	7	..
7. Public welfare tax	4,330,606	1	56
8. Tobacco tax and permits	4,261,315	1	26
9. Alcoholic beverage tax law	1,763,295	1	28-9
10. Insurance license tax	1,106,699	3	7
11. Soft drink tax law	928,986	1	30-1
12. Beer tax	780,320	1	24
13. Occupational license (business and prof.)	994,004	1	58
14. Occupational license (refining petroleum)	593,762	8	..
15. Corporation franchise tax (res. and non-res.)	736,079	4	6
16. Inheritance tax	630,110	4	6
17. Chain store tax (1937-38)	290,717	1	22
18. Kerosene tax and permits (Act 15, 1934)	298,884	1	19
19. Petroleum products inspection of sale	90,958	1	19
20. Power tax (electric and horse power)	819,330	1	28
21. Public utilities	483,182	1	32
22. Natural gas sales tax	162,975	1	53
23. Gas pipeline franchise tax (Act 92, 1936)	37,124	1	54
24. Tick eradication (discontinued since 1938)	249,210	1	21
25. Cotton futures tax	57,733	1	31
26. Chauffeur's license tax	95,997	4	14
27. Fire insurance tax	49,288	5	..
28. Incorporation tax	28,458	6	5
29. Hunting license	79,060	4	12
30. Angler's license	28,181	4	12
31. Trapper's license	11,395	4	12
32. Total from revenue sources listed above	65,088,505	.	..

[1] Second Biennial Report, Collector of Revenue, Department of Revenue, 1938 and 1939, Louisiana.

[2] Biennial Report, State Auditor, Louisiana, 1938-1939.

[3] Baton Rouge State-Times, Wednesday afternoon, March 6, 1940.

[4] Biennial Report, State Treasurer to Governor, Louisiana, 1938-1939.

[5] Ledger in Treasurer's Department.

[6] Report of the Secretary of State, dated January 1, 1939.

[7] Motor Vehicle License Bureau.

[8] Department of Revenue, letter dated January 20, 1941.

severance tax income is needed for expenditure now, the severance tax might be increased and the additional income saved for future expenditures. An additional tax of 10 cents per barrel on petroleum during the years 1935 to 1939, inclusive, would have produced a fund of $41,082,200 in Louisiana, and most of it would have been paid by people living in other regions.

Dr. Raymond D. Thomas says:

> The Southwestern states have borne a real burden not by taxing natural resources but in failing to devise a workable and uniform scheme for converting a larger portion of the mountains of values which have been created from these resources into public income. Here is a case where failure to tax adequately constitutes the burden. The people of the Southwest through the years have purchased automobiles, steel, harvesting machines, and countless other commodities from other producing regions in the national and the world economy. The prices of these purchased goods have borne the hidden loading of taxes of many kinds, including protective tariffs. Through the price system the Southwestern region has contributed in taxes to the support of public services in other regions. This imbalance should be corrected by imposing a tax on our principal regional export of the natural resource products.[3]

Tax Contributions by Parishes

Total: Orleans Parish contributed $14,852,635 to the state income from taxes in 1938; Caddo Parish contributed $7,476,896, and was the only parish to contribute one-half as much as Orleans Parish, while East Baton Rouge ranks third and contributed $3,407,528. Calcasieu, Jefferson and Ouachita parishes contributed slightly more than $2,000,000 each, and seven other parishes contributed between one and two million dollars (Figure 1 and Table 4). There were 51 parishes that paid less than $1,000,000 and 34 less than $500,000. Only one parish, St. Helena, contributed less than $100,000.

The 13 parishes in Louisiana contributing one million dollars or more were the source of 64.4 per cent of the tax revenue of the state, while the other 51 parishes contributed only 35.6 per cent. The contributions of each parish to the gasoline and lubricating oil taxes, the severance, the general property, the income, the motor vehicle, and the sales tax are given in Appendix I, Table A.[4]

Per Capita: The state revenue raised through taxes in Louisiana during 1938 amounted to $27.53 for each man, woman and child. The per capita contributions by parishes to the total state income from taxes, and to certain selected taxes that were the more important sources of income, are shown in Table 2.

The amount of state revenue collected per capita varied widely between parishes. Plaquemines Parish made the highest per capita

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[3] Raymond D. Thomas, "The 'Burden' of Taxation," *The Southwestern Social Science Quarterly,* Vol. XXII (June, 1941), pp. 10-11.

[4] The contributions by parishes to each tax are available but not included because of the space required.

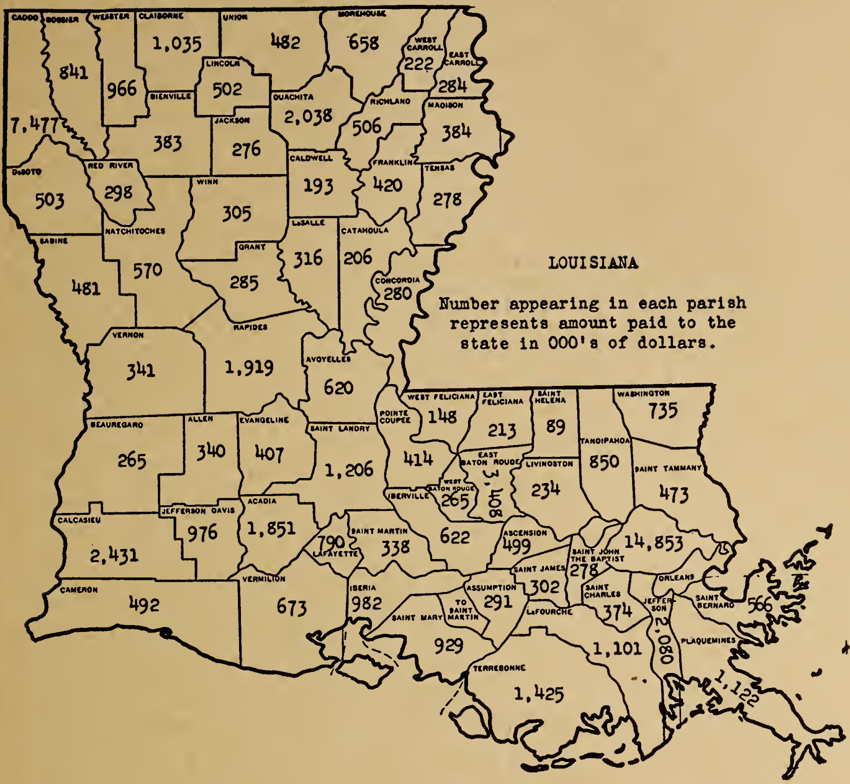

FIGURE 1. Amount of Tax Income Collected by the State from Each Parish, Louisiana, 1938.

contribution of any parish, in the amount of $91.08. This is due in part to the large collection from the severance tax being associated with a sparse population. There were only two parishes, Acadia and Caddo, that were sources of a greater amount of severance tax than Plaquemines, but since both of these parishes have larger populations, they paid a lower per capita tax. St. Helena contributed only $9.35 per capita to the state revenue, and West Carroll, ranking second from the bottom, contributed $11.52 per capita.

The amount of sales tax paid per capita by parishes indicates that people living in towns and cities contribute more to this tax than do people living on farms. East Baton Rouge Parish is dominated by the town population of Baton Rouge and its environs and paid a per capita sales tax of $4.20. Caddo Parish, with Shreveport, paid $3.65; Calcasieu, with Lake Charles, paid $2.74; and Ouachita, with Monroe, paid $3.00 per capita in sales tax. Three largely rural parishes, Catahoula, Union, and Grant, paid 46, 58, and 70 cents per capita in sales tax, respectively.

TABLE 2. TAXES PAID PER CAPITA TO THE STATE OF LOUISIANA, BY PARISHES, 1938[1]

PARISH	All taxes[2]	Gasoline and lubricating oil tax	General property tax	State income tax	Motor vehicle tax	Sales tax
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Acadia	40.02	6.01	3.13	0.96	2.03	1.23
Allen	19.36	6.32	1.73	2.67	2.00	0.87
Ascension	23.53	7.16	3.59	0.38	1.65	1.08
Assumption	15.71	4.08	3.85	0.87	1.28	0.66
Avoyelles	15.79	5.10	3.47	0.14	1.59	0.58
Beauregard	17.84	6.31	2.35	0.32	2.17	1.01
Bienville	15.99	6.40	1.67	0.33	1.52	0.62
Bossier	25.37	7.98	4.13	0.27	1.83	0.76
Caddo	49.78	12.02	4.77	5.06	3.34	3.65
Calcasieu	43.03	11.33	3.02	3.24	2.57	2.74
Caldwell	16.03	5.24	2.59	0.13	1.83	0.77
Cameron	68.33	5.85	3.57	0.35	1.84	0.61
Catahoula	14.10	5.01	2.07	0.24	1.45	0.46
Claiborne	34.65	6.72	2.21	0.87	1.74	1.06
Concordia	19.24	5.51	5.61	0.24	2.02	0.64
DeSoto	15.82	4.60	2.23	0.63	1.53	0.68
E. Baton Rouge	38.54	10.63	7.32	3.27	2.64	4.20
East Carroll	14.94	4.11	3.55	0.24	1.25	0.74
E. Feliciana	11.80	3.21	1.70	0.18	1.03	0.47
Evangeline	13.33	3.21	1.73	0.20	1.12	0.52
Franklin	12.96	4.21	1.90	0.14	1.40	0.56
Grant	17.90	6.20	1.76	1.29	2.22	0.70
Iberia	26.41	7.15	2.83	1.21	1.83	1.61
Iberville	22.44	6.06	4.25	1.94	1.67	1.05
Jackson	15.47	5.30	1.57	0.48	1.80	1.09
Jefferson	41.24	14.11	6.15	0.82	2.16	1.03
Jeff Davis	40.33	8.87	3.27	1.24	2.70	1.67
Lafayette	17.99	6.79	1.83	0.74	1.80	1.54
Lafourche	28.51	8.05	3.34	1.16	1.65	1.29
LaSalle	28.85	9.51	2.03	2.39	2.70	1.27
Lincoln	20.23	7.00	1.96	1.24	1.40	1.14
Livingston	13.14	4.70	1.45	0.07	1.72	0.51
Madison	20.83	6.44	6.11	0.55	1.35	1.04
Morehouse	23.85	5.72	3.23	0.54	1.68	0.95
Natchitoches	13.90	4.62	1.69	0.35	1.28	0.85
Orleans	30.03	6.40	4.42	5.97	2.30	3.22
Ouachita	34.45	11.26	6.00	2.02	2.92	3.00
Plaquemines	91.08	9.00	7.16	0.74	1.54	0.45
Pointe Coupee	17.23	5.08	4.86	0.34	1.35	0.63
Rapides	26.16	10.60	3.46	1.67	2.54	1.74
Red River	18.76	5.16	3.15	0.08	1.28	0.60
Richland	17.56	7.43	2.48	0.14	1.32	0.72
Sabine	20.38	5.22	1.45	0.25	1.60	0.72
St. Bernard	77.75	48.68	14.65	1.01	3.07	1.18
St. Charles	30.35	5.39	9.51	0.32	1.89	0.98
St. Helena	9.35	2.14	1.13	0.01	1.38	0.25
St. James	18.21	4.77	6.12	0.43	1.20	0.63
St. John	18.85	5.98	5.00	0.57	1.36	0.68
St. Landry	16.87	4.75	2.70	0.38	1.34	0.92
St. Martin	12.82	3.40	1.87	0.19	1.18	0.62
St. Mary	29.53	6.53	2.77	1.50	1.35	1.37
St. Tammany	20.02	8.00	1.95	0.82	2.47	1.04
Tangipahoa	18.68	7.23	1.72	0.66	2.34	1.11
Tensas	17.42	5.22	4.83	0.43	1.26	0.68

TABLE 2.—(Continued)

Parish	All taxes	Gasoline and lubricating oil tax	General property tax	State income tax	Motor vehicle tax	Sales tax
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Terrebonne	39.73	8.48	3.05	0.73	1.59	1.74
Union	23.01	5.50	1.99	0.12	1.86	0.58
Vermilion	17.82	7.12	1.70	0.59	1.88	0.83
Vernon	17.79	6.07	1.61	1.47	1.82	0.78
Washington	21.34	6.89	2.13	2.95	2.01	1.26
Webster	28.69	5.75	2.17	0.73	1.61	1.34
W. Baton Rouge	23.52	6.49	7.83	1.62	1.36	0.77
W. Carroll	11.52	3.24	1.41	0.13	1.27	0.63
W. Feliciana	12.62	4.55	1.83	0.09	0.78	0.48
Winn	18.01	7.35	1.55	0.20	1.91	1.06
STATE AVERAGE	27.53	7.33	3.65	2.30	2.03	1.83

[1] Used population reported by 1940 Census.

[2] See Table 1 for taxes, licenses and fees included.

One reason why more sales tax is paid by city residents is that most of them pay a sales tax on everything they eat, while the farmer does not pay a sales tax on the goods he produces for direct consumption or acquires through exchange with his neighbor. The per capita sales tax actually paid by the farmers in some rural parishes may be a little higher than indicated by the data. This would be true to the extent that farm people purchased goods in some other parish in larger amounts than people living elsewhere purchased goods in their parish, owing to the location of trade centers. It is commonly observed, however, that residents of the smaller towns make purchases in distant urban centers to a greater extent than do the people who live on farms.[5]

Tax Revenues Returned to Parishes

During 1938 the state of Louisiana expended $26,996,710 which is traceable to the various parishes. The purposes for which the above sum was used and the amount spent for each purpose are shown in Table 3. Slightly more than one-half of the fund, 52.6 per cent, was used to help support the public schools. The second largest amount of state money was used for public welfare purposes, such as old age assistance, aid to the needy blind and to dependent children. The reimbursement of parishes for homestead exemption required only slightly less money than was used for public welfare. Seventy-nine per cent of the amount expended for various aids to parishes was used for school and welfare expenditures and for homestead exemption reimbursement.

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[5] The sales tax in Louisiana was discontinued on January 1, 1941.

TABLE 3. AMOUNT PAID TO PARISHES BY THE STATE OF LOUISIANA, BY PURPOSE, 1938[1]

PURPOSE	Amount paid to all parishes	Percentage of total
	Dollars	*Per cent*
Registrar of voters	69,356	0.26
Parish fair association	14,603	0.05
Parish health units	279,092	1.03
Parish assessors	178,864	0.66
School purposes	14,200,312	52.60
Confederate veterans	827,422	3.07
Severance tax refund	1,712,520	6.34
Emergency relief	208,512	0.77
Gas tax refund	2,025,602	7.50
Public welfare	3,696,501	13.70
Homestead exemption	3,493,209	12.94
Chain store	290,717	1.08
TOTAL	26,996,710	100.00

[1] The amount paid to each parish is given in Appendix I, Table B.

Generally, the items included in payments to parishes are recurring expenditures that are paid to parishes annually. Expenditures in the parishes in 1938 for the construction of state roads are not included. To have included money spent on state roads would have raised materially the expenditure in those parishes where roads were being constructed in 1938, as compared with parishes where large highway expenditures were made during earlier years.

Table 4 shows the total amount of revenue collected from each parish and the amount returned to each parish for the items listed in Table 3. About 41.5 per cent of the tax money collected by the state in 1938 was returned to local governing units or was paid out to the citizens of the various parishes in the form of pensions, relief and old age security. In Wisconsin, state aids to local governments were equivalent to 53 per cent of all state revenues for the year ending June 30, 1938, or roughly 11 per cent higher than in Louisiana.[6]

The remaining portion of the tax income to the state of Louisiana, amounting to $39,121,795, or 58.5 per cent, was used by the state to defray the costs of administering the state's business, for the operation of the State Teachers College, Louisiana State University, and other state supported colleges, state hospitals, courts, etc.; for the building and maintenance of state roads and bridges, and for the payment of interest and principal on borrowed money. The next section will show to what extent the various parishes contribute to that part of the revenue fund used to support the state government and state institutions.

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[6] Kenneth H. Parsons, Benjamin H. Hibbard, Arthur J. Walrath, *State Aids and Rural Property Taxes in Wisconsin,* University of Wisconsin Agricultural Experiment Station, Madison, Wisconsin, Research Bulletin 138 (March, 1941), p. 2.

TABLE 4. Tax Collections and Allocations, by Parishes, 1938, Louisiana

Parish	1 Tax payments to state by parishes	2	3 Payments by state to parishes	4 Relation between columns 3 and 1	5
	Amount	Rank		Ratio	Rank[1]
	Dollars	*Number*	*Dollars*	*Per cent*	*Number*
Acadia	1,851,429	8	662,943	35.81	14
Allen	339,652	43	246,827	72.67	40
Ascension	499,282	31	265,813	53.24	28
Assumption	291,223	49	179,117	61.50	36
Avoyelles	619,694	25	579,806	93.56	53
Beauregard	264,864	57	292,654	110.49	60
Bienville	382,770	40	348,289	90.99	52
Bossier	841,307	19	311,418	37.02	16
Caddo	7,476,896	2	1,539,684	20.59	2
Calcasieu	2,431,214	4	737,227	30.32	8
Caldwell	193,069	62	209,785	108.66	58
Cameron	492,204	32	135,141	27.46	5
Catahoula	206,051	61	216,624	105.13	56
Claiborne	1,034,558	13	438,854	42.42	21
Concordia	280,141	52	132,926	47.45	26
DeSoto	503,212	29	320,361	63.66	37
E. Baton Rouge	3,407,528	3	759,702	22.29	4
East Carroll	284,257	51	134,302	47.25	25
E. Feliciana	212,901	60	147,138	69.11	38
Evangeline	406,557	38	445,392	109.55	59
Franklin	419,598	36	354,583	84.50	50
Grant	285,189	50	306,609	107.51	57
Iberia	982,089	14	375,441	38.23	17
Iberville	622,192	24	249,616	40.12	19
Jackson	275,533	55	284,698	103.33	55
Jefferson	2,079,515	5	620,775	29.85	7
Jeff Davis	975,671	15	344,637	35.32	12
Lafayette	790,482	20	426,260	53.92	29
Latourche	1,100,808	12	430,164	39.08	18
LaSalle	316,131	45	232,328	73.49	44
Lincoln	501,554	30	372,600	74.29	45
Livingston	233,786	58	364,074	155.73	63
Madison	384,092	39	139,244	36.25	15
Morehouse	657,694	23	301,435	45.83	24
Natchitoches	569,793	26	492,503	86.44	51
Orleans	14,852,635	1	4,195,426	28.25	6
Ouachita	2,038,378	6	655,092	32.14	9
Plaquemines	1,121,950	11	234,299	20.88	3
Pointe Coupee	413,546	37	243,752	58.94	34
Rapides	1,919,020	7	818,862	42.67	22
Red River	297,946	48	228,377	76.65	47
Richland	506,160	28	311,252	61.49	35
Sabine	480,605	34	384,334	79.97	49
St. Bernard	566,033	27	84,334	14.90	1
St. Charles	373,976	41	131,491	35.16	11
St. Helena	89,229	64	169,095	189.51	64
St. James	302,203	47	175,571	58.10	33
St. John	278,376	53	143,904	51.69	27
St. Landry	1,205,884	10	668,270	55.42	32
St. Martin	338,472	44	248,259	73.35	42
St. Mary	928,928	17	331,624	35.70	13
St. Tammany	473,005	35	362,766	76.69	48
Tangipahoa	850,290	18	609,956	71.74	39

TABLE 4.—(Continued)

Parish	1 Tax payments to state by parishes	2	3 Payments by state to parishes	4 Relation between columns 3 and 1	5
	Amount	Rank		Ratio	Rank
	Dollars	*Number*	*Dollars*	*Per cent*	*Number*
Tensas	277,685	54	152,325	54.86	31
Terrebonne	1,425,435	9	460,288	32.29	10
Union	481,937	33	363,268	75.38	46
Vermilion	672,715	22	493,517	73.36	43
Vernon	340,560	42	387,512	113.79	61
Washington	735,086	21	537,861	73.17	41
Webster	966,154	16	437,374	45.27	23
W. Baton Rouge	264,910	56	110,335	41.65	20
West Carroll	221,759	59	268,372	121.02	62
W. Feliciana	147,935	63	80,297	54.28	30
Winn	304,757	46	309,927	101.70	54
ALL PARISHES	65,088,505		26,996,710	41.48	

[1] Parish having the lowest percentage of its payments to the state returned to it is ranked number 1.

Tax Payments versus Tax Allocations

The 11 parishes of Winn, Jackson, Catahoula, Grant, Caldwell, Evangeline, Beauregard, Vernon, West Carroll, Livingston, and St. Helena made no financial contribution to the support of state institutions in 1938, and their own institutions were partially supported by other parishes. In the other 53 parishes, for every dollar paid to the state, 27 received a direct return varying from 50 to 100 cents, while 26 parishes received a return of less than 50 cents. The latter group of parishes made a very substantial contribution to the support of state institutions and government (Figure 2).

The parish of St. Helena received $189.51 in return for each hundred dollars of tax revenue originating in the parish and collected by the state, and the other ten parishes named above received a return ranging from $101.70 to $155.73 for each hundred dollars of taxes paid (Table 5). There were eight other parishes that had returned to them from 75.4 to 93.6 cents for each dollar paid (Table 4).

The eleven parishes making the largest contribution to the support of state institutions are also shown in Table 5. St. Bernard Parish made the best showing and had returned to it only $14.90 for each hundred dollars paid to the state. The ten other parishes making a superior showing from the standpoint of contribution to state support were Caddo, Plaquemines, East Baton Rouge, Cameron, Orleans, Jefferson, Calcasieu, Ouachita, Terrebonne, and St. Charles. All of the 26 parishes that are colored white in Figure 2 are comparatively good.

If more money is returned to some parishes than is collected from them, then the other parishes must be helping to support them. These

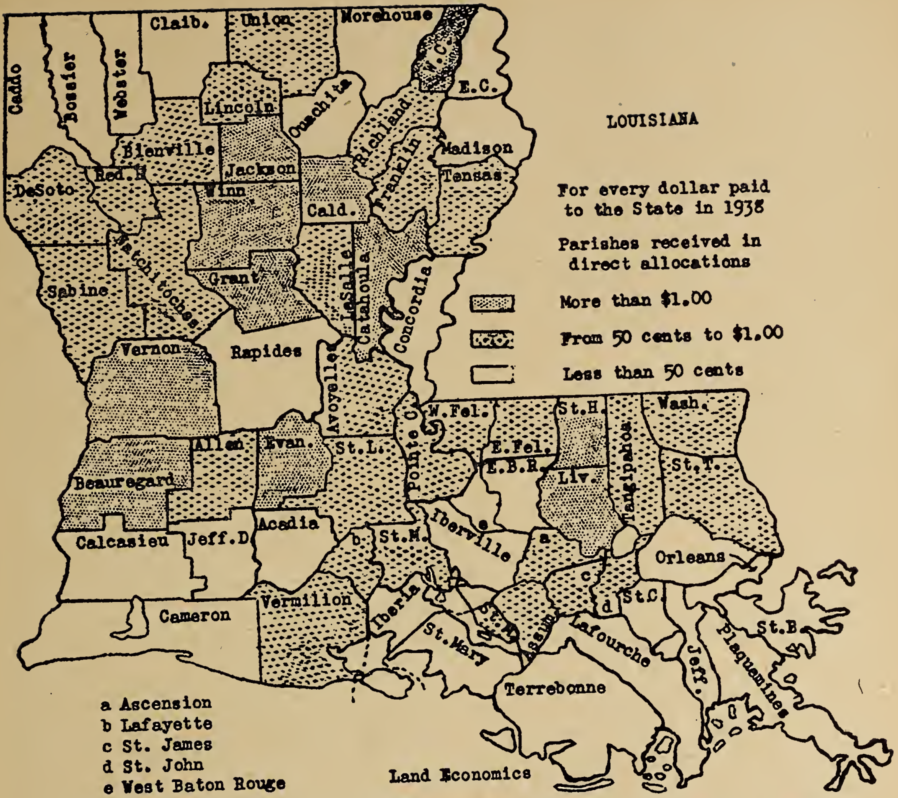

FIGURE 2. Location of Self-Supporting and Non Self-Supporting Parishes, Louisiana, 1938.

other parishes must not only furnish the surplus over payments which is returned to them, but they must bear the entire cost of state government, institutions and roads. To the extent that the foregoing statement is not true during any particular year or period of years, the state must be operating on borrowed money with the anticipation of liquidation at some future time.

The comparison between tax payments to the state and amounts received from the state in 1938 by each of the 64 parishes will have added significance when they may be compared with similar data for other years. Such comparisons at 4- or 5-year intervals would show the trend in the number of parishes that are dependent upon other parishes for the partial support of their local institutions, and for the full support of state institutions and state administration. Such comparisons, however, are limited to the future, since the data necessary to compare even 1933 with 1938 are not readily available, and there is a probability that reasonably full information could not be obtained for 1933 even if large resources were available for the enterprise.

TABLE 5. THE ELEVEN PARISHES RECEIVING ALLOCATIONS FROM THE STATE IN EXCESS OF PAYMENTS TO THE STATE, AND THE ELEVEN MOST CAPABLE PARISHES, LOUISIANA, 1938.

RETURNS EXCEEDING PAYMENTS		ELEVEN MOST CAPABLE PARISHES	
PARISH	Returns per $100 paid to state	Parish	Returns per $100 paid to state
	Dollars		*Dollars*
Winn	101.70	St. Bernard	14.90
Jackson	103.33	Caddo	20.59
Catahoula	105.13	Plaquemines	20.88
Grant	107.51	E. Baton Rouge	22.29
Caldwell	108.66	Cameron	27.46
Evangeline	109.55	Orleans	28.25
Beauregard	110.49	Jefferson	29.85
Vernon	113.79	Calcasieu	30.32
West Carroll	121.02	Ouachita	32.14
Livingston	155.73	Terrebonne	32.29
St. Helena	189.51	St. Charles	35.16

All Parishes Should Plan for Self-Support

If the fact that many parishes are making little or no contribution to the general support of state institutions were a temporary matter due to emergency conditions, it would be of passing interest. The same would be true for those parishes that are also leaning heavily on the other parishes for the support of their local activities. That this situation is temporary cannot be assumed.

There is reason to believe that every parish could contribute to state tax collections at least as much as is paid to it in special aids, provided the people in each parish were adjusted on a sound economic basis to the natural resources of the parish. This would leave the other parishes with the responsibility of supporting themselves and also state-wide activities. Some parishes may need aid in excess of their contributions during the period of time required to overcome the unfortunate results arising out of mistaken policies followed in former years. The point to be stressed is that special aids and exemptions without end and without accompanying remedial measures do not necessarily serve the public welfare. Some kinds of aid may actually encourage among recipients and those dependent indirectly upon them, a lack of interest in a sound economy.

Some parishes could not contribute to state revenue an amount equal to state aids given them at this time without unjustified human sacrifices. That they will ever do so without sound economic planning from within the parish, aided by intelligent help from the state agencies that employ persons competent to give them sound leadership, is at least questionable. It is known that in some localities things are happening which, if not changed, will lead to the need for more instead of less outside aid, that natural resources are being improperly used and that adjustment of people to resources is needed.[7] It is important to guard against special aids encouraging new economic maladjustments that will lead to a need for more aid in relation to tax contributions instead of less.

It is recognized that there are "little men and women" in every state who cannot support themselves adequately at any realistic price level because their contribution to the goods and services which society demands is too small. These people are given an extra share of the annual amount of goods and services produced on the basis of need and public welfare rather than on the basis of their contribution to society.

Some Causes of Present Tax Situations

It seems unlikely that the need for outside support in some parishes is accounted for to a very large extent by their having a larger percentage of people of producing age who are inherently submarginal in productive ability. It is far more likely that the need for outside support is largely due to other factors. Some parishes may have a higher percentage of families trying to make a living by intensive cultivation of land that should be used more extensively, or have 80-acre farms where 160 acres or more are needed. Mortgage debts may be based, to a greater extent in some parishes than in others, on an over valuation of land in relation to its present contribution to a joint product. The costs of roads and local schools per capita may be higher in some parishes than in others because of scattered settlements and longer hauls. In some cases the local tax income may be largely spent in supporting a parish governmental organization, when one overhead organization might serve a larger area nearly as well. Thousands of cutover acres in some parishes are not yielding annual incomes, which means they do not supply opportunity for the employment of local labor that may not have alternative opportunities for full employment.

Other causes for relative inability among parishes to support their local institutions and to help support state activities will occur to every person interested in this subject. No effort has been made to try to list them all. Whatever the reasons or the causes may be, the problem would seem to command the attention of all citizens. If the state interests itself in giving aids without at the same time spending a reasonable amount of effective effort in trying to understand and correct economic maladjustments, it may have more than eleven parishes partially supported by other parishes by 1948.

The Way Toward Better Adjustments

Fortunately, Louisiana has many institutions and intelligent leaders in education, business, and statesmanship whose combined contributions should lead toward a better relation between the land and its human resources. The public school system and the Louisiana State University are making fundamental contributions to progress through furnishing the education necessary for a better understanding of a complicated economic and social environment. Many of the problems are not simple and we cannot make them so by mere wishful thinking.

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[7] See Louisiana Experiment Station Bulletin No. 322 and Mimeographed Circular No. 12.

Among the significant current efforts is the agricultural planning program in Louisiana. This is an especially hopeful process, because rural men and women are cooperating with the College of Agriculture and the United States Department of Agriculture in analyzing problem situations within the parishes, and combining their judgments on what should be done to bring about better conditions. Time is required for people to study and obtain an understanding of the problems suggested by this article, but not much will be done about them until farmers and urban citizens do understand the causes of maladjustments resulting from unsound economic organization.

The state of Louisiana also has an official planning organization whose function it is to encourage and correlate sound economic and social development. The importance of what this planning organization might do in guiding and giving intelligent direction to planning bodies for different industries and interests in the state is just beginning to be understood. It seems that many of the problems facing the state have economic, social, and political aspects that are more difficult to solve than are the technical engineering problems. The success of any planning group depends almost entirely on a thorough understanding of the conditions which it hopes to improve through intelligent leadership. It cannot succeed in a democracy by virtue of its official authority.

Summary and Conclusions

(1) Eleven parishes in Louisiana received special aids and welfare payments from the state in 1938 in excess of their contributions to the tax and license income collected by the state. Except during periods when state indebtedness is increasing, or a fund collected in former years is being disbursed, these excess payments must be paid from collections made in other parishes. Also, these other parishes must support the state government and state institutions.

(2) Insofar as the need of some parishes for philanthropy is temporary, the situation described is of passing interest. That the present situation is temporary, or that more aids may not be required in the future, cannot safely be assumed. Without action based upon careful analysis and public understanding of the problems involved, additional parishes may be expected to need funds in excess of their contributions to state revenue.

(3) Since it is the policy of the state to equalize educational opportunities, to give old age assistance, to help support needy families, to exempt homesteads having certain minimum valuations, and to extend other aids or exemptions from taxation in the interest of public welfare, it seems necessary that it should also interest itself to an increasing extent in means and measures necessary to prevent the need for larger amounts of aid from arising. Without intelligent planning, there is danger of encouraging new enterprises that are financially unsound, and of increasing the number of individuals willing to place more and more responsibility for their support upon the public through organized government.

(4) With a better adjustment of resources to people, and the use of all farm and non-farm land according to its productive capacity, it should ultimately be possible for each parish to contribute as much to state revenue as it receives in return for the support of local institutions and welfare aids. It may be that a few parishes are so deficient in natural resources that they will not be able to make any contribution to the support of state government and institutions, although they share with the others in their benefits.

(5) Some attention should be given to the question as to whether a fund should be accumulated during the time when nonreproducible resources are being severed for use when the supply has been greatly reduced. An additional severance tax on products consumed to a considerable extent outside of the region would help to offset hidden taxes and tariffs paid by southerners on products purchased by them and produced in other regions.

APPENDIX I

TABLE A. ESTIMATED AMOUNT COLLECTED BY PARISHES THROUGH SOURCES PRODUCING 77.6 PER CENT OF TOTAL STATE TAX COLLECTIONS, LOUISIANA, 1938.

PARISH	AMOUNT COLLECTED FROM SELECTED SOURCES OF REVENUE					
	Gasoline and lubricating oil tax	Severance tax	General property tax	Income tax	Motor vehicle tax	Sales tax[1]
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Acadia	278,174	991.302	144,568	44,430	93,778	56,813
Allen	110,833	1,651	30.371	46,747	35,244	15,201
Ascension	151,811	99,414	76,170	7,958	34,976	23,003
Assumption	75,576	439	71,400	16,046	23,759	12,185
Avoyelles	200,138	927	136,070	5,369	62,442	22,765
Beauregard	93,672	2,691	34,842	4,825	32,236	15,067
Bienville	153,111	11,550	39,856	7,833	36,489	14,737
Bossier	264,533	116,342	136,836	8,921	60,790	25,130
Caddo	1,804,910	2,005,769	716,047	760,412	501,368	547,867
Calcasieu	640.227	776,125	170,584	183,256	145.009	154,821
Caldwell	63,148	7,059	31,151	1,512	22.002	9,321
Cameron	42,156	372,131	25,685	2,524	13,242	4,421
Catahoula	73,270	1,631	30,215	3,508	21,135	6,677
Claiborne	200,570	505.793	65,992	25,865	52,026	31,523
Concordia	80,187	3.224	81,680	3,443	29,382	9,337
DeSoto	146,350	37,319	70,817	20.066	48,587	21,528
E. Baton Rouge	940,243	7,847	647,260	288,922	233,333	371,752
East Carroll	78,263	3,847	67,604	4.569	23,846	14,107
E. Feliciana	59,005	6,926	30,669	3,324	18,506	8.533
Evangeline	97,832	55,243	52,638	6,011	34,032	15,798
Franklin	136,487	934	61.644	4,373	45,235	18,092
Grant	98,717	6,878	28,097	20,539	35,402	11,170
Iberia	265,989	237,107	105,141	45.115	67,864	59,863
Iberville	167,948	55,813	117,936	53,688	46,274	29,173
Jackson	94,383	5,311	27,994	8,611	32,078	19,475
Jefferson	711,419	580,105	310,332	41,177	108,678	51,852
Jeff Davis	214,472	413.377	79,198	29,950	65,297	40,282
Lafayette	298,282	69	80,602	32,599	78,956	67,505
Lafourche	310,814	298,052	128,856	44,761	63,529	49,671
LaSalle	104,246	57,397	22,244	26,175	29,607	13,865
Lincoln	173,495	53,754	48,555	30,624	34,717	28,347
Livingston	83,671	3,804	25,881	1,224	30,666	9,019
Madison	118,685	4,976	112,666	10,150	24,942	19,097
Morehouse	157,582	182,190	89,192	14,786	46,250	26,083
Natchitoches	189,269	8,081	69,126	14,262	52,653	34,688
Orleans	3,165,204	911	2,183,766	2,952,020	1,138,407	1,590,355
Ouachita	666,453	172,839	354,916	119,810	172,763	177,386
Plaquemines	110.937	831,709	88,217	9,095	18,994	5,534
Pointe Coupee	121,875	1,546	116,611	8,067	32,323	15,046
Rapides	777,651	23,674	253,586	122,834	186,389	127,383
Red River	81,955	60,173	50,082	1,289	20,263	9,564
Richland	214,247	18,156	71 584	3,971	38,070	20,679
Sabine	123,036	147,447	34,240	5,972	37,816	17,073
St. Bernard	354,392	66	106,620	7,360	22,318	8,591
St. Charles	66,423	1,185	117,234	3,965	23,247	12,041
St. Helena	20,454	822	10,816	92	13,170	2,386
St. James	79,147	195	101,610	7,147	19,976	10,402
St. John	88,282	395	73,845	8,431	20,062	10,096
St. Landry	339,485	135,710	193,279	26,947	95,905	65,566
St. Martin	89.772	22,012	49,479	5,097	31,034	16,296
St. Mary	205,234	327,734	87,083	47,171	42,524	43,099
St. Tammany	188,922	7,541	46,018	19,267	58,405	24,527

TABLE A—(Continued)

PARISH	AMOUNT COLLECTED FROM SELECTED SOURCES OF REVENUE					
	Gasoline and lubricating oil tax	Severance tax	General property tax	Income tax	Motor vehicle tax	Sales tax
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Tangipahoa	329,206	12,729	78,221	30,124	106,695	50,659
Tensas	83,186	1,330	76,967	6,924	20,148	10,891
Terrebonne	304,175	680,550	109,419	26,071	57,121	62,444
Union	115,218	174,431	41,758	2,480	38,870	12,222
Vermilion	268,745	24,591	64,313	22,117	70,919	31,404
Vernon	116,259	13,299	30,818	28,220	34,847	14,992
Washington	237,422	6,804	73,213	101,637	69,166	43,504
Webster	193,481	396,105	73,097	24,673	54,238	45,234
W. Baton Rouge	73,080	737	88,151	18,233	15,340	8,675
West Carroll	62,420	3,621	27,236	2,420	24,473	12,143
W. Feliciana	53,336	2,342	21,483	1,001	9,119	5,638
Winn	124,440	16,708	26,180	3,465	32,323	18,008
ALL PARISHES	17,333,905	10,000,440	8,617,761	5,439,476	4,789,255	4,330,606

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[1] Called public welfare tax in 1938.

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938.[1]

PURPOSE OF PAYMENTS	Acadia	Allen	Ascension	Assumption	Avoyelles	Beauregard	Bienville	Bossier
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1. Registrar of voters	1,200	630	630	510	870	630	690	570
2. Parish fair association	none	none	none	none	375	619	375	375
3. Parish health unit	6,388	none	none	6,514	7,001	none	6,618	5,300
4. Parish assessor								
4*a* From general fund	290	103	119	106	109	90	110	136
4*b* From school fund	1,368	484	559	501	514	426	518	642
4*c* Bond and interest fund	629	223	257	231	236	196	238	295
4*d* Engineer's fund	175	62	72	64	66	55	66	82
5. School purposes								
5*a* Per educable	221,568	82,560	99,008	87,824	182,176	65,088	131,840	139,184
5*b* Equalization	none	81,722	36,293	none	116,407	105,820	67,137	none
5*c* Teacher retirement	13,406	6,205	5,408	3,543	10,723	5,753	7,198	7,988
5*d* Books and supplies	17,821	5,893	10,419	4,554	15,983	9,872	9,060	10,864
5*e* Free school fund	625	861	419	1,138	2,061	4,021	1,779	3,120
6. Confederate veterans	20,088	6,696	8,705	6,696	31,471	10,044	18,079	10,044
7. Severance tax	182,744	1,059	17,805	100	198	451	2,397	21,626
8. Emergency relief	none	none	none	1,584	none	none	none	333
9. Gas tax refund	47,982	none	17,948	10,712	25,798	12,103	20,696	37,872
10. Public welfare	68,333	33,548	32,233	30,381	65,387	38,994	32,640	31,557
11. Homestead exemption	74,655	24,580	33,279	22,353	115,394	36,391	45,417	37,336
12. Chain store	5,671	2,201	2,659	2,306	5,037	2,101	3,431	4,094
13. TOTAL	662,943	246,827	265,813	179,117	579,806	292,654	348,289	311,418

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938—(Continued).

PURPOSE OF PAYMENTS	Caddo	Calcasieu	Caldwell	Cameron	Catahoula	Claiborne	Concordia	DeSoto	E. Baton Rouge
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	1,450	1,350	510	450	510	630	450	570	1,450
2	none	376	none	375	none	244	375	375	132
3	17,688	none	5,940	none	6,393	5,200	6,309	5,058	5,656
4									
4a	2,703	349	67	118	64	148	85	169	2,064
4b	17,469	1,647	317	558	302	700	403	795	9,735
4c	8,036	757	146	257	139	322	185	366	4,478
4d	2,236	211	41	71	39	90	52	102	1,246
5									
5a	586,928	209,248	53,104	28,816	66,048	155,168	62,224	178,976	290,480
5b	none	10,383	65,050	none	69,500	23,927	none	none	none
5c	45,656	14,198	3,780	3,366	4,672	9,366	2,082	8,679	19,491
5d	72,181	19,763	6,848	2,570	6,476	14,004	4,662	8,817	30,913
5e	4,233	1,998	771	1,157	1,634	1,567	3,093	2,203	514
6	44,663	20,758	6,026	670	5,357	8,035	2,009	16,071	32,141
7	200,000	164,839	1,352	69,158	365	106,857	832	7,620	1,005
8	3,480	none	1,800	none	500	none	none	none	24,000
9	217,952	87,881	10,170	9,547	10,750	23,233	14,121	19,159	128,610
10	161,142	103,594	27,729	10,475	17,534	33,418	19,512	29,164	97,351
11	135,888	93,823	24,630	7,553	24,545	51,289	14,689	37,764	100,600
12	17,979	6,052	1,504	none	1,796	4,656	1,843	4,473	9,836
13	1,539,684	737,227	209,785	135,141	216,624	438,854	132,926	320,361	759,702

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938—(Continued).

PURPOSE OF PAYMENTS	E. Carroll	E. Feliciana	Evangeline	Franklin	Grant	Iberia	Iberville	Jackson	Jefferson	Jeff Davis
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	450	450	750	990	570	1,010	630	570	1,350	690
2	459	none	none	none	375	none	none	376	none	375
3	none	none	none	7,374	none	5,870	6,216	none	none	7,255
4										
4*a*	87	109	135	139	73	170	145	81	301	173
4*b*	408	514	635	654	346	803	684	380	1,421	818
4*c*	188	237	292	301	159	369	315	175	654	376
4*d*	52	66	81	84	44	103	88	49	182	105
5										
5*a*	67,744	80,928	134,752	150,608	78,368	148,848	124,176	77,968	194,352	109,664
5*b*	none	none	149,727	74,159	119,732	none	none	100,315	none	none
5*c*	2,930	525	8,747	10,321	6,581	8,279	5,609	6,596	14,500	7,625
5*d*	6,624	6,330	17,646	11,346	10,347	8,103	11,614	7,436	19,167	10,136
5*e*	4,772	379	4,582	1,169	1,681	1,632	702	1,014	288	1,956
6	1,339	12,053	9,374	5,357	11,383	20,088	9,374	17,410	2,009	5,351
7	878	783	6,416	211	1,478	45,823	10,863	1,086	106,184	85,592
8	none	none	none	none	none	none	6,000	none	none	none
9	11,481	8,571	13,929	17,468	14,899	36,174	20,772	14,107	60.635	28,000
10	21,306	16,027	40,401	27,654	38,851	41,631	24,906	25,550	75,131	39,126
11	13,303	17,650	54,250	42,345	19,457	52,472	23,969	29,594	138.828	44,545
12	2,281	2,516	3,675	4,403	2,265	4,066	3,553	1,991	5,773	2,850
13	134,302	147,138	445,392	354,583	306,609	375,441	249,616	284,698	620,775	344,637

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938—(Continued).

PURPOSE OF PAYMENTS	Lafayette	Lafourche	LaSalle	Lincoln	Livingston	Madison	Morehouse	Natchitoches	Orleans	Ouachita
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	1,350	375	570	570	690	450	570	810	23,641	1,200
2	none	none	none	375	375	459	none	375	none	864
3	6,240	6,690	5,550	5,580	none	8,498	6,573	5,859	none	14,867
4										
4*a*	187	165	100	107	62	131	197	173	6,301	541
4*b*	880	780	470	504	293	617	927	817	29,723	2,550
4*c*	405	359	216	232	135	284	427	376	13,672	1,173
4*d*	113	100	60	65	37	79	119	105	3,804	326
5										
5*a*	194,720	188,976	54,880	111,664	82,400	69,040	118,832	216,400	1,697,648	241,632
5*b*	6,737	none	73,687	82,378	142,176	none	none	75,452	none	10,000
5*c*	9,016	8,889	4,669	7,705	5,956	3,351	7,695	10,198	none	16,946
5*d*	12,556	11,829	7,265	16,939	8,445	4,477	11,557	14,770	184,914	19,768
5*e*	175	1,539	2,608	942	1,607	3,731	1,947	4,743	927	1,099
6	22,766	8,035	8,705	20,088	10,714	2,009	15,401	23,436	105,797	16,740
7	2	60,006	10,618	11,242	770	979	36,219	1,689	13	37,716
8	none	none	none	1,200	none	none	3,200	none	121,222	21,135
9	34,743	50,185	14,579	22,335	9,856	14,603	22,577	27,624	181,021	92,909
10	47,673	52,490	32,788	35,029	43,954	19,484	38,802	59,897	1.045,424	110,169
11	83,098	35,071	13,880	52,354	56,604	8,913	32,976	44,230	715,160	57,621
12	5,599	4,675	1,683	3,291	none	2,139	3,416	5,549	66,159	7,836
13	426,260	430,164	232,328	372,600	364,074	139,244	301,435	492,503	4,195,426	655,092

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938—(Continued).

PURPOSE OF PAYMENTS	Plaquemines	Pointe Coupee	Rapides	Red River	Richland	Sabine	St. Bernard	St. Charles	St. Helena
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	570	570	1,350	570	570	750	570	510	450
2	none	375	375	375	none	375	none	244	375
3	none	7,263	12,283	5,505	5,821	none	none	3,930	none
4									
4a	188	100	306	83	107	73	126	178	51
4b	888	470	1,443	392	505	344	594	840	239
4c	408	216	664	180	232	158	273	387	110
4d	114	60	185	50	65	44	76	108	31
5									
5a	54,272	121,696	276,208	79,168	125,440	126,416	33,168	58,832	45,104
5b	none	11,480	80,501	54,464	59,228	56,877	none	1,796	53,794
5c	2,507	5,845	16,786	5,252	5,717	9,314	2,267	3,434	3,129
5d	2,903	4,811	28,359	5,363	13,832	5,040	1,971	5,196	4,696
5e	761	1,174	8,988	1,512	1,866	1,161	294	693	612
6	none	6,696	30,802	7,366	4,687	19,418	none	3,348	6,696
7	122,684	346	4,553	10,419	4,231	26,283	12	95	239
8	none	5,000	3,066	600	none	825	none	none	none
9	15,531	17,493	92,285	11,951	18,582	20,728	14,929	10,066	7,345
10	14,846	33,421	112,710	25,621	28,639	62,903	18,610	21,828	26,108
11	18,627	23,707	138,559	19,506	37,927	50,148	11,444	18,259	20,116
12	none	3,029	9,439	none	3,803	3,477	none	1,747	none
13	234,299	243,752	818,862	228,377	311,252	384,334	84,334	131,491	169,095

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938—(Continued).

PURPOSE OF PAYMENTS	St. James	St. John	St. Landry	St. Martin	St. Mary	St. Tammany	Tangipahoa	Tensas	Terrebonne
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	510	510	1,200	690	570	990	1,350	450	570
2	375	none	none	none	375	375	375	459	none
3	none	none	10,346	5,285	15,107	none	none	5,628	7,975
4									
4*a*	131	205	299	116	312	193	166	81	195
4*b*	617	966	1,412	547	1,471	909	782	383	918
4*c*	284	444	650	252	677	418	360	176	422
4*d*	79	124	181	70	188	116	100	49	118
5									
5*a*	76,128	72,240	339,104	124,560	138,272	96,384	216,752	68,800	166,912
5*b*	18,618	none	none	none	none	60,723	115,297	5,812	4,264
5*c*	5,083	3,810	11,861	3,382	6,379	6,294	14,799	3,779	8,326
5*d*	6,721	5,896	15,690	5,759	6,699	9,343	16,496	6,196	8,047
5*e*	461	701	2,450	1,022	1,563	2,152	4,188	6,245	783
6	4,018	2,678	28,123	12,053	8,705	7,366	18,749	4,687	6,696
7	1	117	27,248	4,188	62,426	1,640	3,047	403	137,952
8	5,670	none	none	none	1,636	165	1,208	none	none
9	12,204	10,416	50,059	13,287	30,163	35,522	45,843	10,762	44,157
10	24,778	29,055	78,421	33,105	31,927	48,457	72,379	20,541	40,350
11	17,681	14,712	92,563	40,804	20,915	88,701	91,399	15,697	28,303
12	2,212	2,030	8,663	3,139	4,239	3,018	6,666	2,177	4,300
13	175,571	143,904	668,270	248,259	331,624	362,766	609,956	152,325	460,288

APPENDIX I—(Continued)

TABLE B. PAYMENTS TO PARISHES BY THE STATE, CLASSIFIED BY PURPOSE, LOUISIANA, 1938—(Continued).

PURPOSE OF PAYMENTS	Union	Vermilion	Vernon	Washington	Webster	West Baton Rouge	West Carroll	West Feliciana	Winn	Total All Parishes
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1	570	900	750	870	690	450	570	450	570	69,356
2	375	none	375	864	none	375	375	132	375	14,603
3	5,363	5,223	none	6,912	5,620	none	6,194	none	none	279,092
4										
4a	122	135	104	161	165	122	77	96	86	20,185
4b	574	638	493	761	780	574	363	451	405	99,921
4c	264	293	227	350	359	264	167	207	186	45,964
4d	73	82	63	97	100	73	46	58	52	12,794
5										
5a	99,680	176,336	98,016	156,256	126,704	49,216	79,840	46,624	75,632	9,911,600
5b	105,742	109,361	160,352	163,642	109,583	none	87,503	none	101,613	2,771,252
5c	9,778	10,014	7,599	12,131	8,759	3,052	6,431	1,911	5,901	501,192
5d	11,871	12,391	9,584	28,323	10,483	4,156	7,158	2,754	7,478	899,185
5e	1,737	365	2,570	2,362	1,241	106	1,861	451	1,077	117,083
6	10,044	18,079	11,383	10,044	12,053	1,339	2,009	2,009	13,392	827,422
7	35,965	3,649	2,434	1,862	60,873	150	709	512	3,506	1,712,520
8	none	none	42	none	1,400	4,446	none	none	none	208,512
9	15,988	31,849	18,630	38,770	24,504	11,593	9,460	7,448	15,035	2,025,602
10	23,473	43,797	48,341	58,266	25,555	24,446	27,240	9,553	42,846	3,696,501
11	41,649	75,547	23,658	51,877	44,257	8,572	36,365	6,066	39,644	3,493,209
12	none	4,858	2,891	4,313	4,248	1.401	2,004	1,575	2,129	290,717
13	363,268	493,517	387,512	537,861	437,374	110,335	268,372	80,297	309,927	26,996,710

[1] See Appendix III for source of data.

APPENDIX II

A. List of taxes where amount collected by parishes in 1938 is a matter of record. (Numbers are same as those appearing in Table 1.)

3. *Severance tax.* Actual collections. See data pages 42 and 43, Second Biennial Report, Collector of Revenue, for 1938 and 1939.

4. *General property tax.* Actual collections. See data on pages 48 and 49, Biennial Report of the State Auditor for 1938 and 1939.

5. *Income tax.* Percentage used to allocate total income taxes collected based on collections reported by parishes on pages 34 and 35, Second Biennial Report, Collector of Revenue, for 1938 and 1939.

7. *Public welfare tax.* Based on collections reported for 1938 on page 56 of the Second Biennial Report, Collector of Revenue, for 1938 and 1939. Miscellaneous item of $76,272.30 distributed on basis of percentage relations between actual distributions shown in the report.

13. *Occupational license* (business and professions). As collected. See page 58, Second Biennial Report, Collector of Revenue, for 1938 and 1939.

14. *Occupational license* (refining petroleum products). 22 refineries—Direct from Department of Revenue in letter dated January 20, 1941, from Joseph E. Loftin, Assistant Director, Department of Revenue.

17. *Chain store tax.* As collected. See page 22, Second Biennial Report, Collector of Revenue, for 1938 and 1939.

25. *Cotton futures tax.* Paid in New Orleans only. All credited to Orleans. See page 31, Second Biennial Report of the Collector of Revenue, 1938-39.

27. *Fire insurance tax.* Data obtained direct from ledger of Treasurer. (Act 18 of 1924, as amended by Act 66 of 1930.) Redistributed to incorporated places as collected.

B. Method used to estimate amount by parishes for those taxes where only the total amount of collection is shown on the official record. (Numbered same as Table 1.)

1. *Gasoline tax.* Allocation of total based on percentage of 2-cent gasoline tax collected by parishes in 1936. Data furnished by Louisiana State Highway Commission.
2. *Lubricating oil tax.* Same percentage as used in distributing gas tax.
6. *Motor vehicle tax.* Allocation based on the percentage which the actual number of automobiles and trucks (weighted by 1½) is of the state total. For the state as a whole, the tax collected per truck was approximately 1½ times the amount collected per automobile.
8. *Tobacco tax and permits.* Allocation based on percentage distribution of total population of the state of Louisiana by parishes as of 1940. Assumption is that collections on this tax will vary directly with population.
9. *Alcoholic beverage tax law.* Same as number 8.
10. *Insurance license tax.* Same as number 8.
11. *Soft drink tax law.* Same as number 8.
12. *Beer tax.* Same as number 8.
15. *Corporation franchise tax* (resident and nonresident). Use percentage of income tax paid by parishes to allocate state total. Based on assumption that the amount of income tax paid by parishes would vary directly with corporate sources of employment and investment in corporate shares.

APPENDIX III

Source of Data Showing Payments in 1938 to Parishes as Reported in Appendix I, Table B.

1. *Registrar of voters.* Records of State Auditor, appropriation books 44 and 45. Covers amounts paid to registrar and deputy registrar of voters.
2. *Parish fair association.* Records of State Auditor, appropriation books 44 and 45. Louisiana 4-H Livestock Fair and Rice Festival not included. (See publication, Louisiana Fairs, 1939 Season.) When two or more parishes held fairs together, premium money was divided.
3. *Parish health unit.* Records in office of Supervisor of Public Funds.
4. *Parish assessors.* Records of State Auditor, appropriation books 44 and 45. Assessors are paid from four funds as follows: 4*a*, General Fund; 4*b*, Public School Fund; 4*c*, State Bond and Interest Tax Fund; 4*d*, State Engineer's Fund.
5. *School purposes.* Expenditures of school funds by parishes are separated into five divisions:
   - 5*a*. Per educable. Bulletin 402, Eighty-Ninth Annual Report for the Session 1937-38, pages 140 and 141. Sixteen dollars per educable was appropriated during 1937-38 and during 1938-39.
   - 5*b*. *Equalization school fund.* Records of State Auditor, appropriation books 44 and 45. Also Biennial Report of State Department of Education, 1937 and 1938. Bogalusa, Monroe and Lake Charles are shown separately in records, but have been included in the data for the parish in which the respective city is located.
   - 5*c*. *Teacher retirement.* Records in State Department of Education.
   - 5*d*. *Free books, paper and pencils.* Bulletin 402 issued by the State Department of Education, 1937-38, pages 196-197 and 199-201. Pencil paper cost 41 cents, writing paper 53 cents per package of 1,000 sheets, and pencils cost $1.18 per gross. Price data were obtained from former official of the State Printing Board now transferred to the Purchasing Department.
   - 5*e*. *Free school fund* consists of interest accruing from proceeds of sale of 16th section land. Records of State Auditor, appropriation book 44.
6. *Confederate veteran fund.* Biennial Report and List of Pensioners of the State of Louisiana, by Board of Pension Commissioners, 1938, pages 41 and 42. Also report for 1940, page 4. The number of veterans or their widows is shown in the former report by parishes, and the amount paid in 1938 in the latter report. Payments to each pensioner were at the rate of $60 per month in 1938. From the total paid to pensioners, deductions were made in the amount estimated to have been paid to pensioners living in other states. The average amount paid pensioners in 1938 as determined by multiplying the number of pensioners listed by $720 was reduced 7 per cent by reason of deaths during the year.
7. *Severance tax.* Biennial Report of State Auditor, Louisiana, 1938-1939, page 64.
8. *Emergency relief.* Records of State Auditor, appropriation books 44 and 45.
9. *Gas tax two-cent refund.* Same as 8.
10. *Public welfare grants.* Data prepared by statisticians in the Bureau of Research and Statistics, Department of Public Welfare. From January through June 30, the amount received by each parish was determined by the amount of gas tax paid. During the remainder of 1938, the amount allotted to each parish was determined by the Department of Public Welfare according to the Act of 1938. Public assistance grants do not include administrative costs.
11. *Homestead exemption* (property tax relief fund). Twenty-Second Annual Report of the Louisiana Tax Commission for 1938, pages 272-273.
12. *Chain store.* Second Biennial Report of the Collector of Revenue, Department of Revenue, 1938 and 1939, page 22.

16. *Inheritance tax.* Same basis as used to allocate the income tax (No. 5). Assumption is that income taxes reflect wealth and income and inheritance taxes collected would be related to wealth and income.

18. *Kerosene tax and permits.* Percentage of dwellings without electric meters. Number of dwellings less number of dwellings with electric meters. See Consumer Market Data Handbook, 1939 edition, page 156.

19. *Petroleum products inspection of sale* (Act 14, 1932 as amended). Estimate on same basis as gasoline tax (No. 1).

20. *Power tax* (electric and horse power). Distribution based on percentage of dwellings with electric meters.

21. *Public utilities.* Based on percentage of state assessment of public utilities in each parish. See Cooper, W. A., Second Biennial Report of the Collector of Revenue, 1938-39, p. 32; also Twenty-Second Annual Report of the Louisiana Tax Commission for the year 1938, tabulation No. 67, for assessed valuations of public service corporations by parishes.

22. *Natural gas sales tax.* Distributed on basis of percentage of population in each parish in 1940.

23. *Gas pipeline franchise tax* (Act 92, 1936). Distributed on basis of population in 1940.

24. *Tick eradication* (Repealed 1938). Distributed on basis of population.

26. *Chauffeur's license tax.* These are issued to bus and truck drivers. Allocation on basis of percentage of buses and trucks in each parish.

28. *Incorporation tax.* The difference in the number of corporations reported in 1937 and in 1938 was used to represent the number of incorporations during 1938. Since the incorporation tax is based on size of business, the average assessed valuation of all corporations in the parish was weighted by the number of new incorporations during 1938. These weighted data were then determined on a percentage basis by parishes and used as a basis for distributing the incorporation tax collected.

29. *Hunting license* 30. *Angler's license* 31. *Trapper's license*	These three small items were thrown together and distributed on basis of population for convenience.

NOTE: Material on this page is continuation from bottom page 29.

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LOUISIANA BULLETIN NO. 338 FEBRUARY, 1942

Factors Affecting Profits *From* Dairy Herds

By

D. M. SEATH AND E. W. NEASHAM

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W. G. TAGGART, *Director*

SUMMARY AND INDEX OF FINDINGS

1. Monthly and yearly Louisiana dairy herd improvement association records on cows in 32 herds during 1938, 33 herds in 1939, and 25 herds in 1940 were used for the study.
2. High yielding cows were decidedly more profitable than were low yielding cows. For each 1,000-pound increase in yearly yield of milk, the return per cow over feed cost increased $21.30. (See page 4 and Table 1.) Likewise, for each 100-pound increase in butterfat yield, the return per cow over feed cost increased an average of $44.96. (See page 5 and Table 2.)
3. It costs more to feed high producing cows, yet the three-year average showed that for each $1.00 increase in feed cost, the return over feed cost increased $2.40. (See Tables 1 and 2.)
4. The 11 high producing herds for 1938, when compared to the 11 low producing herds for that year, averaged 66 per cent higher in feed costs yet returned 69 per cent more over feed cost per cow. Ten cows in the high producing herds returned as much as 17 cows in the low producing herds. (See pages 5 and 6 and Figure 1.)
5. The feeding of grain at the rate of one pound for each 3.0 to 3.4 pounds of milk produced proved the most profitable, while the heaviest grain feeding (1 to 1.4 and under) was the least profitable. (See pages 7 and 8, Table 3, and Figure 2.)
6. March, April, May, and June were the high months both in production per cow and in average returns over feed cost. These are the months when good pastures are usually available. The poor-pasture months of November and December ranked lowest in average production and in returns over feed cost. (See pages 8 and 9 and Table 4.)
7. Monthly milk and butterfat averages for herds showed a close relationship to percentage of cows dry within herds. Herds averaged 324 pounds of milk per cow when more than 40 per cent were dry and 559 pounds of milk when less than 10 per cent were dry. (See page 10.)
8. The 10 herds having the highest percentage of cows dry for the year 1939 (25.4 per cent), when compared to the 10 averaging lowest in percentage dry (13.2 per cent), produced 29 per cent less milk and 40 per cent less fat per cow. The return over feed cost averaged $33.81 less per cow, or $1,386 less for the average-sized herd (41 cows) studied. (See pages 10 and 11.)
9. Two herds having cows of comparable breeding, but one provided with better pasture and roughage, when compared for a two-year period showed a difference of one gallon of milk per cow per day and $71.04 in returns over feed cost per cow per year in favor of the herd with good pasture and roughage. (See page 12 and Table 7.)
10. Recommendations based on the findings relative to breeding, culling, record keeping and pasture production are given. (See pages 13, 14, and 15 and Figure 3.)

FACTORS AFFECTING PROFITS FROM DAIRY HERDS

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MILK AND NATIONAL DEFENSE

Dairying in Louisiana holds a most important position in National Defense. Louisiana farmers have been asked to increase their milk production 5 per cent. This increase in production has been asked so that food can be supplied to nations resisting aggression. It has been aptly stated that "food will win the war and write the peace," and while thoughts on National Defense usually include guns, ammunition, airplanes, ships and tanks, one must not forget that the farmers who produce the vital foods are standing shoulder to shoulder with industry in full support of armed forces.

Milk heads the list of defense foods. There must be an expansion in production now. Dairymen want to know how best to get the increased production necessary. It should be in a sound, practical manner so that no hardships will result after the emergency. A study of actual herds where production records are being kept points out methods that are sound and practical. The average production of cows in dairy herd improvement associations in Louisiana is far above that of the average cow being milked in the state. A careful analysis of the results secured by these better herds should point out the route to both a greater and a more profitable production of milk in Louisiana.

DAIRY RECORD STUDY

Source of Data

Data gathered from Louisiana dairy herds by cow testing supervisors in charge of record keeping for dairy herd improvement associations were used in this study. These data were sent to the state dairy extension office in the form of either monthly or yearly reports and were based on actual monthly weights and tests of the milk and a record of feed consumption for each cow. Feed records were kept on all cows that had freshened at least once, whether actually in production or dry. Feed prices and the value of the milk sold were taken from actual conditions as they existed on each farm for each month. Records of cows in 32 herds during 1938, 33 herds in 1939, and 25 herds in 1940 were included in the study.

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* The authors gratefully express their appreciation to J. N. Efferson, of the Agricultural Economics Department, for his assistance during the first phase of this study.

High Milk Production Increases Returns

Yearly records of the milk production and feed consumption of cows give dairymen a splendid opportunity to measure their relative value in a herd. It is more important to know that a cow averaged two gallons daily for 10 months during the year than it is that she produced three gallons when first fresh and an unrecorded amount thereafter.

TABLE 1. Relation of Yearly Milk Yield Per Cow to Returns Over Feed Costs
(Averages of three testing years ending July 1st of 1938, 1939, and 1940)

No. Cows (Total)	Pounds Milk		Gallons* Per Day	Pounds Butterfat	% Fat	Roughage Cost	Grain Cost	Total Feed Cost	Return Over Feed Cost†
	Class	Actual Yield							
18	2,000	2,109	0.8	109	5.2	$11	$16	$ 27	$ 36
46	3,000	3,091	1.2	151	4.9	13	24	37	56
115	4,000	3,992	1.5	188	4.7	16	28	44	76
79	5,000	5,010	1.9	231	4.6	18	33	51	99
100	6,000	5,996	2.3	282	4.7	21	43	64	116
71	7,000	6,965	2.7	320	4.6	23	48	71	138
43	8,000	7,944	3.0	386	4.9	28	58	86	152
20	9,000	8,958	3.4	424	4.7	30	63	93	176
20	10,000	9,837	3.8	467	4.7	28	67	95	200
10	11,000	10,889	4.2	495	4.5	31	73	104	223

For each 1,000-pound increase in production, the returns over feed cost increased $21.30.

*Yield in gallons per day based on a 10-month lactation of 305 days.

†Product was valued at average price for three-year period of $3.00 per cwt.

As shown in Table 1, there was a rapid increase in returns over feed costs as yearly production increased. For example, the cows in the 3,000-pound group that actually averaged 3,091 pounds of milk per year, or 1.2 gallons daily for a normal lactation of 305 days, exceeded those in the 2,000-pound group by only 0.4 gallons daily per cow, yet the added returns over feed cost were $20 per cow, or 55 per cent greater than in the 2,000-pound group. Increased returns of this proportion would total $200 per year for a herd of 10 cows.

Good dairy cows, when fed on good roughage and a moderate amount of grain, can be expected to produce yearly 6,000 pounds of milk per cow. As shown in the table, cows in this class averaged 2.3 gallons daily during a normal lactation. Their feed cost averaged $64, or 2.4 times that of the cows in the 2,000-pound class, yet in returns over feed cost their average of $116 per cow is 3.2 times the average of the lower producing group.

Group comparisons show that $21.30 was the average increase in returns over feed costs that accompanied an increase of 1,000 pounds in milk yield. Feed costs increased too as production of milk and butterfat increased, but as shown below in Table 2, there was a more rapid increase in the income over feed, with $2.40 the average increase for each $1.00 increase in feed cost.

High Fat Yields Increase Profits

As with milk, it is important that cows have a high yearly fat yield if they are to be very profitable (see Table 2). Each increase of 100 pounds in fat yield was accompanied by a $44.96 increase in returns over feed cost. When butterfat prices are below the average value found in this study of 63 cents, it is even more necessary that high production be maintained. If calculated at 40 cents, as in the extreme right-hand column of Table 2, it takes more than two cows in the 300-pound class with a return over feed cost of $50 to equal the actual $119 return over feed recorded by this group. In spite of this, the $50 return over feed per cow is a fair return for 300-pound cows on most Louisiana dairy farms and, as is shown in Table 2, is more than three times that for cows producing 100 pounds, which is approximately the average yield of Louisiana milk cows.

TABLE 2. RELATION OF YEARLY BUTTERFAT PRODUCTION TO RETURN OVER FEED COST
(Average of three testing years ending July 1st of 1938, 1939, and 1940)

No. Cows (TOTAL)	POUNDS FAT		% Fat	Pounds Milk	Cost of Roughage	Cost of Grain	Total Feed Cost	Return over Feed*	Return Over Feed Cost (Fat @ 40c)
	Class	Actual Average							
21.......	100	105	4.5	2354	$11	$16	$27	$ 39	$ 15
82.......	150	152	4.5	3354	12	25	37	59	24
126.......	200	198	4.7	4257	17	29	46	79	33
98.......	250	249	4.5	5539	18	36	54	103	46
78.......	300	298	4.7	6351	24	45	69	119	50
60.......	350	350	4.9	7147	25	50	75	145	65
34.......	400	399	4.9	8080	29	57	86	165	74
25.......	450	453	4.8	9485	29	67	96	189	85
15.......	500	492	4.9	10103	27	70	97	213	100

For each $1.00 increase in feed cost, returns over feed increased $2.40. For each 100-pound increase in butterfat production, returns over feed increased $44.96.

*All values of butterfat calculated at three-year average price of 63 cents per pound.

An increase in total fat yield is the result of an increase in total milk or in fat test, or both. As a rule an increase in total milk yield has the greatest influence. This is shown in Table 2, although the high fat producing cows also had a slightly higher test than did those in the lower producing groups.

High Producing Herds Receive More Feed But Yield Greater Profits

Not only do high producing individual cows produce milk more economically than do low producing cows, but also herds of high average production hold a distinct advantage over herds with a low average production. This trend was found for each of the three years studied.

As a measure of this trend the 11 high producing herds for 1938 were compared to the 11 low producing herds for that year. The division was made on the basis of the yield of 4 per cent equivalent milk.* The comparative yields, feed costs and returns from these two groups of herds are shown in Figure 1. The results reveal the following:

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* Pounds 4 per cent equivalent milk=40 per cent of milk yield+15 times the fat yield.

(1) The 11 high producing herds produced 67 per cent more 4 per cent equivalent milk per cow than did the 11 low producing herds; thus 10 cows in the high producing herds yielded as much milk as 17 cows in the low producing group.

(2) In spite of a 66 per cent average increase in feed cost per cow, the high producing herds realized 69 per cent more return over feed cost per cow than did the low producing herds. (4 per cent milk was valued at $2.00 per cwt.)

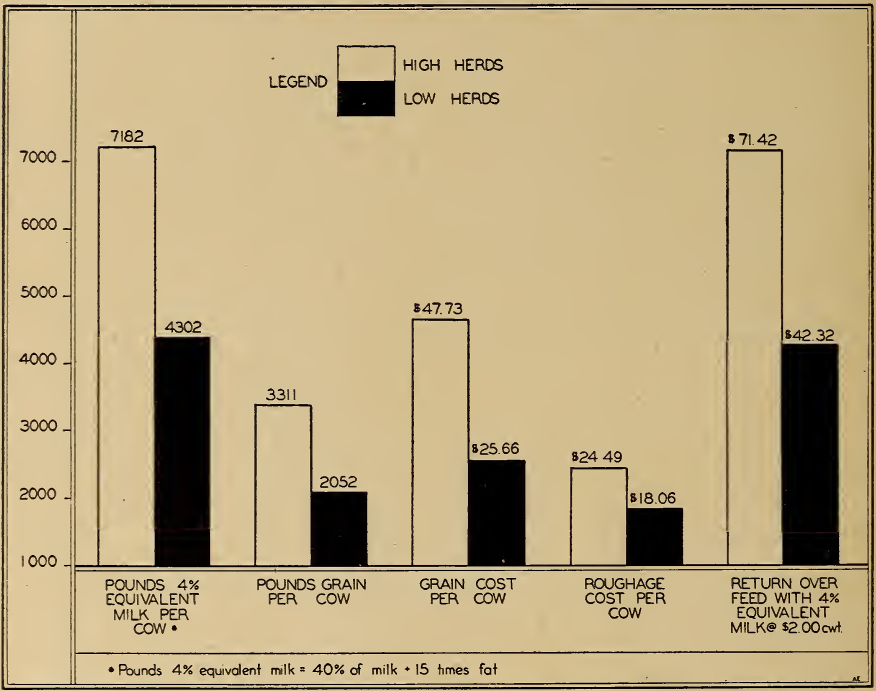

FIGURE I. Yearly Comparison of Eleven High and Eleven Low Herds—1938

The return over feed cost from 10 cows in the high producing herds equaled that from 17 cows in the low producing herds. Where 10 cows, well fed, will return as much over feed cost as 17 inferior cows, poorly fed, the labor involved will be reduced around 40 per cent, with the necessary equipment, pasture area and barn space proportionately reduced. These added reductions would be significant, for a previous study of Louisiana dairy farms showed that costs other than feed represented an average of 43 per cent of the total cost of producing milk.*

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* Louisiana Experiment Station Bulletin No. 325, *An Economic Study of Dairy Farms in the Kentwood Area of Southeastern Louisiana, 1937-38,* June, 1940, p. 12.

In these herds the extra feed necessary to feed the high producing herds resulted in a proportionate increase in returns over feed cost. When dairy cows of poor producing ability are involved, this extra feed cannot be expected to give comparable results, yet most dairy herds will increase in profitableness as the amount of feed they receive increases and its quality improves.

How Amount of Grain Fed Influences Profits

Does heavy grain feeding pay, or is it more profitable to provide good pasture and other roughage, and feed sparingly on grain? A study of the monthly reports for these herds over a three-year period gave a partial answer to this question.

The feeding of either a moderate or a minimum amount of grain proved most profitable for each of the years studied. The three-year average (see Table 3) showed that the greatest return over feed cost resulted when one pound of grain was fed for each 3.0 to 3.4 pounds of milk produced. The actual monthly return per cow over feed cost was $11.72 for this most profitable group, whereas the low return of $4.53 per cow was the average for those receiving one pound of grain for each 1.4 or less pounds of milk. The liberally grain-fed group showed a monthly grain cost per cow of $4.52, which exceeded by $1.98 the grain cost for the most profitable group. This difference did not alone account for the $7.19 difference between returns over feed cost for the two groups. The remaining difference was largely accounted for by the greater average production of the moderately grain-fed group of 518 pounds of milk, as compared to the heavily grain-fed group of 429 pounds of milk per cow. The roughage costs for the various groups remained relatively constant. Feed costs per hundred pounds of milk progressively reduced from $1.48 to $0.65 as the rate of grain feeding reduced.

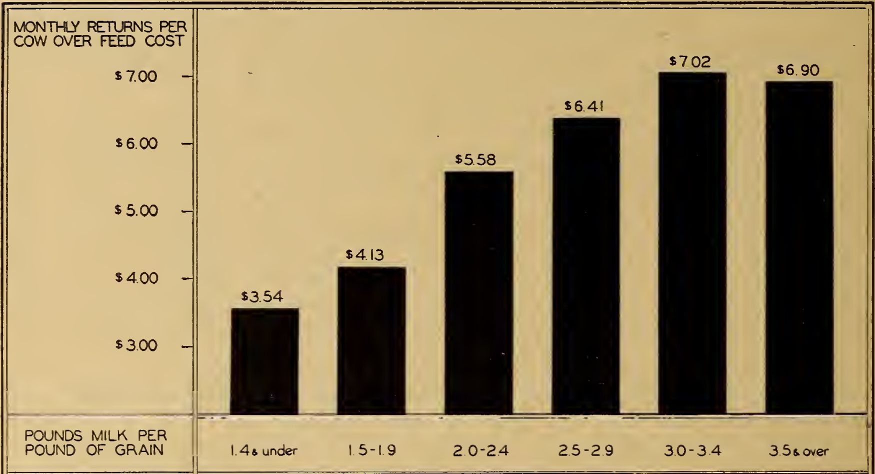
TABLE 3. THE RELATIONSHIP BETWEEN RATE OF GRAIN FEEDING AND MONTHLY RETURNS FROM DAIRY COWS

(Three-year average, 1938 to 1940, inclusive)

POUNDS OF MILK PRODUCED PER POUND OF GRAIN FED	Number Monthly Cow Records (Totals)	Month's Milk Per Cow	MONTHLY FEED COST PER COW			Monthly Return Per Cow Over Feed Cost	Feed Cost Per 100 lbs. Milk
			Roughage	Grain	Total		
1.4 and under..........	6697	429	$1.81	$4.52	$6.33	$ 4.53	$1.48
1.5 to 1.9..............	13244	441	1.67	4.08	5.75	6.97	1.30
2.0 to 2.4..............	10778	480	1.70	3.18	4.88	8.98	1.02
2.5 to 2.9..............	6916	516	1.68	3.00	4.68	11.37	0.91
3.0 to 3.4..............	2825	518	1.58	2.54	4.12	11.72	0.80
3.5 and over............	1744	451	1.39	1.54	2.93	10.23	0.65
TOTAL OR AVERAGE..	42204	468	1.67	3.40	5.07	8.45	1.08

A somewhat fairer comparison of the relative profitableness of these different levels of grain feeding can best be had if the price of the product is standardized under a sliding scale which varies with the per cent butterfat in the milk. Such a comparison with 4 per cent milk at $2.00 per hundred is shown in Figure 2. Even under this standardized price the grain feeding rate of one pound to each 3.0 to 3.4 pounds of milk remains the most profitable, although the differences are not as great as are the actual ones shown in Table 3. Moderate grain feeding (1 to 3.0—3.4) averaged $7.02 per cow per month, and exceeded by 98 per cent the monthly average return of $3.54 for heavy grain feeding.

Obviously light grain feeding in itself will not cause a higher production than secured from heavy grain feeding, nor will it alone be responsible for greater returns over feed costs. Cows that are producing heavily on moderate amounts of grain are receiving also either good pasture or other high-grade roughage. This is shown in the monthly comparison (see Table 4), with a high production of milk during March, April, and May in the face of a widening in the ratio of grain feeding.



POUNDS MILK PER POUND OF GRAIN	1.4 & under	1.5-1.9	2.0-2.4	2.5-2.9	3.0-3.4	3.5 & over
MONTHLY MILK PER COW (LBS.)	429	441	480	516	518	451
TOTAL FEED COST	$6.33	$5.75	$4.88	$4.68	$4.12	$2.93
FEED COST PER CWT LBS. MILK	$1.48	$1.30	$1.02	$0.91	$0.80	$0.65

FIGURE 2. Relation of Rate of Grain Feeding to Monthly Returns Over Feed Cost
(Prices based on $2.00 for 4% milk and actual feed costs)

Monthly Variations in Yields and Returns

Variations in a herd's record from month to month often reflect changes due to climatic variations. The production of milk and butterfat per cow, as shown in Table 4, reflects just such a condition. Louisiana climate is such that good pastures are normally available during March, April, May, and June and parts of July, and these five months rank high in production per cow and in returns over feed cost. As contrasted to this, milk yields per cow were lowest for November and December, during a period when dairy pastures are normally the poorest. The lowest average return over feed cost, $6.92 per cow, was for January, a month with a comparatively low average milk yield and the highest total feed cost of any month. During January one pound of grain was fed for each 1.7 pounds of milk produced—the narrowest ratio of any month. Likewise the months of February, October, November and December showed grain feeding of a ratio of either 1.0 to 1.8, or 1.0 to 1.9. The three-year average for all months was 1.0 to 2.0, and this is considered to be at least 50 per cent heavier than is most profitable for those farms having an abundance of high-grade roughage.

TABLE 4. MONTHLY VARIATIONS IN PRODUCTION AND FEED COSTS
(Average of 1938, 1939, and 1940)

MONTH	Average No. Cows Per Herd	Per Cent of Cows Dry	MONTHLY PRODUCTION PER COW (LBS.)		MONTHLY FEED COST PER COW		Return Over Feed Cost Per Cow	Pounds Milk Per Pound of Grain Fed
			Milk	Fat	Roughage	Grain		
Jan.....	37.4	18.5	449	21.8	$2.85	$3.71	$ 6.92	1.7
Feb.....	37.6	18.6	445	21.0	2.62	3.44	7.24	1.8
Mar.....	38.1	17.6	515	23.5	2.22	3.77	8.91	2.0
Apr.....	38.0	16.2	528	24.1	1.39	3.57	10.36	2.1
May....	40.1	15.8	520	23.3	1.00	3.33	10.45	2.2
June....	38.9	16.9	478	21.7	0.98	3.39	9.24	2.1
July....	39.4	18.4	472	21.3	1.01	3.19	9.22	2.1
Aug.....	39.8	19.9	455	20.9	1.07	3.16	8.63	2.0
Sept.....	40.2	19.0	446	20.4	1.17	3.22	8.27	2.0
Oct.....	39.8	19.6	454	21.6	1.51	3.32	8.26	1.9
Nov.....	39.6	19.3	423	20.8	1.95	3.28	7.16	1.8
Dec.....	39.6	19.1	441	21.4	2.44	3.53	7.28	1.8
AVERAGE	39.0	18.2	469	21.8	1.67	3.40	8.45	2.0

During each of the years studied the herds averaged slightly larger at the end than at the beginning of the year. The three-year average (Table 4) showed 37.4 cows in January and 39.6 cows in December, an increase of 2.2 cows. This indicated a 6 per cent yearly increase in milk cow numbers, probably brought about by a growing demand for dairy products and because herd owners found the enterprise profitable. On an average 18.2 per cent of the milk cows were dry, with 15.8 per cent the least for any month (May). August, with 19.9 per cent dry, was the high month.

How Dry Cows Affect a Herd's Performance

As shown in Table 4, there is a variation from month to month in the percentage of milk cows dry. Within individual herds this variation is more striking, for the average of a large number of herds tends to permit a herd with a low percentage dry for a certain month to offset the effect of a herd with a high percentage dry for that month.

TABLE 5. THE EFFECT OF DRY COWS ON MONTHLY PRODUCTION FROM DAIRY HERDS
(Three-year average)

PER CENT OF HERD DRY	Number of Monthly Herd Records	MONTHLY PRODUCTION PER COW (POUNDS)	
		Milk	Fat
Under 10	232	559	27.0
10 to 19	417	490	23.1
20 to 29	308	433	19.6
30 to 39	100	375	16.8
40 and over	19	324	13.3
AVERAGE, 18.2	...	468	21.8

In Table 5 the immediate effect of having a high or a low percentage of cows dry during a month is shown. The milk yield averaged 559 pounds per cow during months when less than 10 per cent of the cows were dry, and only 324 pounds when 40 per cent or more were dry. Likewise the average fat yield reduced from 27.0 pounds to 13.3 pounds per cow as the percentage dry increased from less than 10 to 40 per cent. The majority of the monthly averages showed from 10 to 30 per cent of the cows dry, and the three-year average was 18.2 per cent dry.

Herds vary much in the percentage of cows dry for any particular year. During 1939, for example, 33 herds varied from a herd having an average of only 6.7 per cent dry, to a herd averaging 33.3 per cent of the cows dry for the year. A grouping of the 33 herds into the low 10, the medium 13, and the high 10, on the basis of the average percentage of the cows which were dry during the year, provided a means of observing the influence of percentage dry on the average production and returns from the herds. The results of such a grouping are shown in Table 6.

On the basis of assuming that a cow needs a dry period of 60 days each year and that one-fourth of the milking herd is made up of first-calf heifers, an ideal reproduction record would be one in which approximately 12.5 per cent of the herd was dry during the year. The low group on percentage (see Table 6) averaged 13.2 per cent dry and ranged from 6.7 per cent to 14.8 per cent. The medium group of 13 herds ranged from 16 per cent to 19.6 per cent dry and averaged 17.8 per cent for the year. Still higher are the 10 high herds with an average of 25.4 per cent dry. It is of interest to note that the average number of cows per herd increased slightly as the percentage of cows dry decreased. This may indicate that the good record on percentage dry of certain herds in the low group is due to the inclusion of large commercial herds which depend on selling cows immediately after they go dry and buying, as replacement, cows either already fresh or about to freshen.

As shown in Table 6, it is quite evident that there is a direct relationship between the average percentage of cows dry during the year and the

TABLE 6. A Comparison of Production and Returns from Herds Grouped According to Percentage of Cows Dry

Percentage of Herd Dry		No. of Herds	Aver. Cows Per Herd	Aver. No. Cows Dry Each Mo.	Aver. Production Per Cow			Feed Cost Per Cow			Return Over Feed Cost With Product @ 60c. lb. ot Fat
Range	Aver.				Milk (lbs.)	Fat (lbs.)	% Fat	Grain	Rough-age	Total	
Low Group 6.7-14.8....	13.2	10	50	5.5	6347	307	4.8	$46.76	$18.38	$65.14	$119.10
Med. Group 16.0-19.6...	17.8	13	45	7.9	5449	260	4.8	37.52	25.47	62.99	93.01
High Group 20.7-33.3...	25.4	10	37	9.4	4923	220	4.5	35.02	11.69	46.71	85.29

average production per herd. The 4,995 cows in the 10 herds with the lowest percentage of dry cows averaged 6,347 pounds of milk and 307 pounds of fat. In milk yield, this is 16 per cent more than the 5,449-pound average of the medium group and in fat yield 18 per cent more than the medium group's average of 260 pounds. The 10 herds averaging 25.4 per cent of their cows dry for the year averaged only 4,923 pounds of milk and 220 pounds of fat. This was 29 per cent less milk and 40 per cent less fat than that produced by the 10 herds having the low percentage of dry cows.

Herds having the lowest percentage of dry cows averaged the highest in milk and fat production, but in order to do this they had the highest feed cost per cow. This was caused primarily by a higher grain cost, $46.76 for the year, which was $9.24 more than the medium group and $11.74 more per cow than the high group on percentage dry. Roughage costs did not vary in this regular order, for they were greatest for the medium group. The total average feed costs per cow were $65.14 for the low group, $62.99 for the medium group, and $46.71 for the group having the highest percentage of dry cows.

Returns over feed costs, when butterfat was standardized at 60 cents per pound, distinctly favored the herds having the low percentage of dry cows, even though this group averaged highest in feed cost. Those 10 herds averaged $119.10, the medium group $93.01, and the 10 herds with the highest percentage of dry cows $85.29 per cow. Differences found favored the best group by $26.09 per cow over the medium group and by $33.81 per cow over the group having the highest percentage of cows dry. When applied to the average-sized herd among the 33 studied (41 cows), this difference represents an added income over feed, for those having the lowest percentage of cows dry, of $1,070 per year more than for the medium group and $1,386 more per herd than for the group having the high percentage of cows dry.

With and Without Good Pasture and Roughage

As an example of the important part that improved pasture and high-grade roughage play in increasing the production and the profitableness of a herd, the 1939 and 1940 records of two herds from the same Louisiana dairy herd improvement association are compared in Table 7. Herd number one had access to excellent pasture, including oats in the winter, clover in the spring and summer, and sweet potato vines in the fall. Herd number two was on pasture the year around but did not have access to either improved permanent pasture or the supplemental succulent grazing crops. In addition to this difference, the number one herd received legume hay and silage during a portion of the year, whereas there were only one or two months of the year when herd number two received roughage other than pasture, and during that period it received common hay.

The two herds had comparable dairy cows, each having purebred Jerseys as a portion of its herd. The rate of grain feeding was much heavier for the herd receiving the poor roughage, the ratio of pounds of grain to pounds of milk produced being 1 to 2.1 as compared to a ratio of 1 to 2.8 for the herd with good roughage.

Not only did good roughage reduce the rate of grain feeding, but it caused a marked increase in yield of milk. The herd receiving good roughage averaged 18.8 pounds (2.2 gallons) of milk per cow per day for a normal 305-day lactation, as compared to the poor-roughage herd's average of 10.0 pounds (or 1.2 gallons) of milk per day. Returns over feed cost at a uniform price of 60 cents per pound of butterfat showed $122.88 per cow for the herd having good roughage and only $51.84 per cow for the herd receiving the poor roughage. To realize $2,000 over feed cost, herd number one would need to milk only 17 cows, whereas herd number two would require 39 cows. Herd number one actually averaged 21.0 cows, while herd number two had 38.2 cows. At the uniform price of 60 cents per pound of butterfat, herd number one averaged $2,580.48 over feed cost per year, or $600.19 more than did herd number two and kept an average of 17 less cows. If other costs such as labor, equipment, taxes, and interest were considered, the advantage of the number one herd would be even greater.

TABLE 7. COMPARISON OF HERDS WITH AND WITHOUT GOOD PASTURE AND ROUGHAGE (Average for 2-Year Period, 1939-1940)

HERD NO.	Type of Pasture and Roughage	PRODUCTION PER COW			YEARLY FEED COST PER COW			Yearly Return Over Feed Cost Per Cow With Fat @ 60c per Pound
		AVER. LBS. MILK						
		Yearly	Daily*	% Fat	Roughage	Grain	Total	
1............	good	5722	18.8	5.2	$27.23	$28.69	$55.92	$122 88
2............	poor	3048	10.0	4.6	10.61	21.55	32.16	51.84

*Daily milk yield average was based on 305-day lactations.

PRACTICAL SOLUTION OF PROBLEMS RAISED

The results of this study have shown the advantages of developing herds of high average production. They have also pointed out certain factors which influence the development and maintenance of such a herd. The remaining portion of this bulletin covers some of the practical methods to employ in controlling these factors.

Good Bulls and Close Culling Are Essential

Two practical methods of improving the milk-producing inheritance of a herd are open to the dairyman. The first one is to mate the present cows in his herd to a purebred dairy bull that is backed by high milk and butterfat production. This bull can best be selected from a herd that has all of its cows tested each month for production. This permits the buyer to select a bull from a family whose members have proved to be uniformly high producers, rather than to take chances on buying a bull with only one animal's record to be used in appraising his value. Particular attention should be paid to the average records of the bull's half sisters, both on the sire and dam side of the pedigree. The successive use of bulls (of the same breed) whose daughters produce more than their dams, will result in a gradual increase in the herd's average production.

The second method of improving the average inheritance of a herd is to systematically cull out the low producing cows in the herd. To do this intelligently requires the daily use of the milk scales and periodic butterfat tests of the milk from each cow in the herd. The basis of culling should be the records of each cow's yearly yield of milk and butterfat, and her feed consumption. Besides culling low producers it is essential that diseased cows, such as those having mastitis, Bang's disease, and tuberculosis, be eliminated.

A Need for Accurate and Complete Records

Good dairymen find a constant use for accurate and complete records. Records of production, either private ones or those secured by being a member of a cooperative dairy herd improvement association, are invaluable in the proving of sires for high production and in the selecting of female families most pure in their inheritance for high production. A consideration of these points permits intelligent culling.

Records of the service and calving dates for each cow in the herd permit the dairyman to dry up cows at the proper time and to condition them for calving. Nothing contributes more to high production of milk cows than to allow six to eight weeks dry period prior to each calving and to feed cows during that period so that they accumulate a little reserve condition from which they may draw on after calving.

Following birth each calf should be ear-marked by use of a tatoo or ear tag, so that its identity will never be lost. A permanent herd record should have a list of all calves born, their ear mark, sire, dam, and date of birth. This information will later permit herd owners to practice culling based on a complete family history.

Must Be Disease-free to Have High Breeding Efficiency

Regular tests for such diseases as Bang's disease are necessary if herds are to remain free from disease and maintain a high level of breeding efficiency. High fertility depends on both the bull and the female. Each must be free from reproductive diseases and in a good state of health. A high breeding efficiency and a low percentage of cows dry in a herd both depend on a regular breeding schedule. Service and calving records should be used as a guide to determine the best time to breed cows and when to turn them dry. The ideal situation is to have each cow in the herd calve each 12-month period, be in milk 305 days, and be dry six to eight weeks. In order to average this calving record, it is necessary to breed cows an average of one heat period (21 days) before the date when one figures it is necessary. This is required, because even the best herds average around two services for each pregnancy. The plan then would be to start breeding cows approximately two months following calving, and dry them off six to eight weeks before they calve again.

Improved Pastures Necessary

Nothing will contribute more toward higher production per cow and cheaper feed costs than will improved dairy pastures. Permanent pastures need improvement so that they will provide green succulent feed over a longer period of time than do the unimproved ones. Some of the steps necessary to accomplish this are: (a) frequent mowing to control weeds; (b) the establishment of both clovers and productive grasses; and (c) frequent fertilization. The proper fertilizers and the kind and amounts of seed to use will vary depending on the type of soil. One should consult his local county agricultural agent for detailed recommendations.

Temporary grazing crops play a big part in rounding out a pasture program, even when the best of permanent pasture is available. These crops supply green succulent grazing during periods of the year when permanent pasture either is not productive or has become dry and fibrous. These failings for permanent pasture make it desirable to use crops such as oats during fall, winter and spring, Sudan grass for late summer and early fall, and sweet potato vines for late fall. The months when these crops are most productive are shown in Figure 3. Other crops which can be grown to supplement permanent pasture are rye, rye grass, barley, soybeans, and kudzu. Vetch, when combined with a cereal such as oats, also makes a good grazing crop.

Feed Moderate Amounts of Grain

As was shown by the study, the feeding of moderate amounts of grain along with good quality roughage permits herds to become more profit-

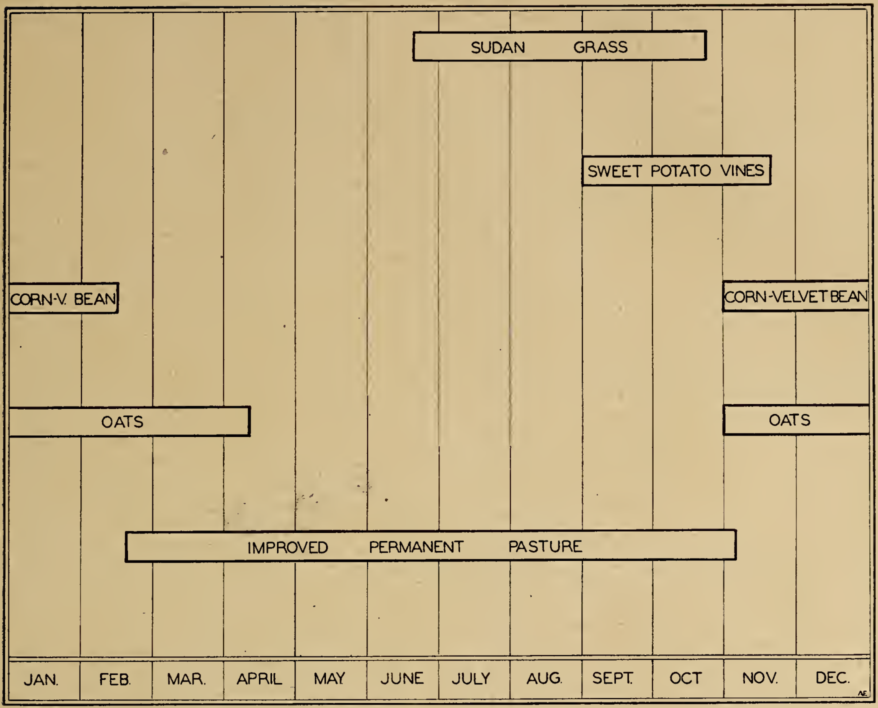


FIGURE 3. A Balanced Dairy Pasture Program, Showing Months When Various Crops Furnish Grazing.

able. Regardless of the amount fed, the grain should always be portioned out to the cows proportionate to the amount of milk produced. On an average, one pound should be fed for each 2.5 to 3.5 pounds of milk produced. The narrower ratio is more appropriate for high testing cows, such as Jerseys, while the wider ratio fits low testing cows, such as Holsteins. Variation from this "thumb" rule should be made for cows whose response varies from the average, and when the ratio between the prices of roughages and grain varies in an abnormal fashion.

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LOUISIANA BULLETIN NO. 339 FEBRUARY, 1942

The New Orleans Market For Fluid Milk

By

REID M. GRIGSBY AND ROY A. BALLINGER

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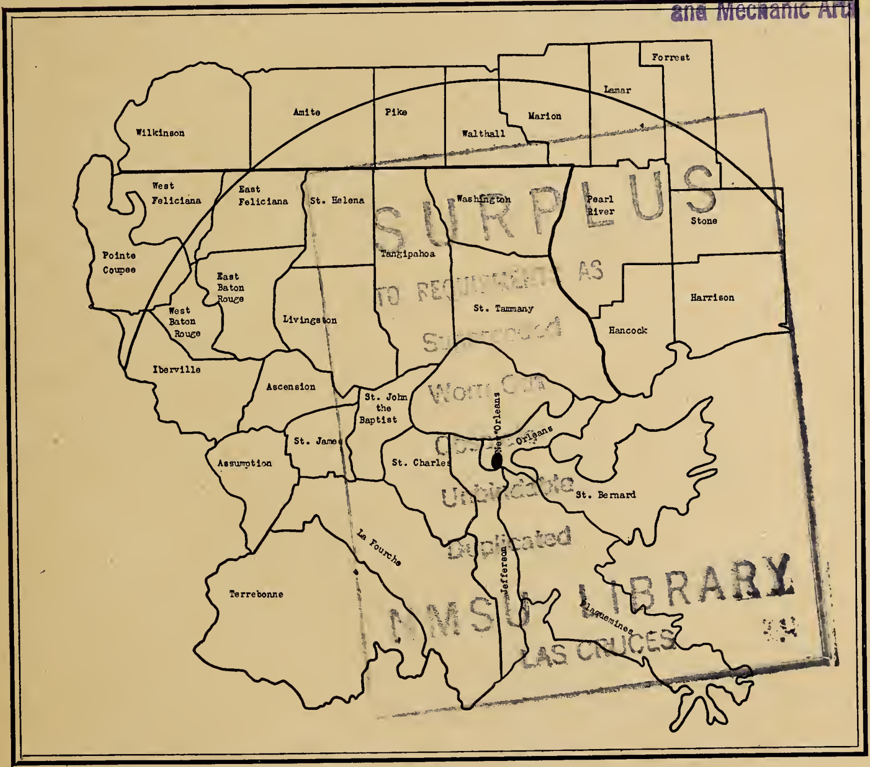

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NEW ORLEANS MILKSHED
Most of the milk for the New Orleans market is produced north of the city, within a radius of 80 miles. In some cases the distance by highway or railroad is greater.

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS
W. G. TAGGART, *Director*

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THE NEW ORLEANS MARKET FOR FLUID MILK

Reid M. Grigsby and Roy A. Ballinger*

Introduction

The people living in the city of New Orleans and surrounding suburbs consumed annually about 185 million pounds of fluid milk or its equivalent in the years immediately prior to 1941. This included the amounts used as fluid milk, cream, ice cream, and creamed and cottage cheese. It was divided among approximately 540,000 people, who lived within an area of about 365 square miles, of which 199 were land and 166 water. Approximately 35,000 milk cows were kept within a radius of 120 miles of the city to supply the market.

Many of the present problems connected with the marketing of milk in the city can be better understood if the historical circumstances preceding the present situation are briefly reviewed. In 1850, the city of New Orleans had a population of only 5,300. Prior to 1852, the city had no railroads except one small line of about five miles in length.[1] The first shipment of milk to New Orleans by rail is supposed to have been made from Milneburg in 1864, by this line. Until railroad transportation developed, the milk supply of New Orleans came largely from dairy herds located within the city limits and fed principally on brewery mash. The City Board of Health incurred many of its problems early in life, for in 1873 the Health Department made the following complaint:

> A sanitary nuisance was caused by the conditions of cow stables, known then as 'Vacheries,' attached to a large number of dairies situated on Gaiennie Street, from Constance to Annunciation Streets. The Board of Health deplored the fact that it lacked the power to force the owners of these cow stables to move their dairies beyond St. Charles Avenue. The Sanitary inspector stated that it was proverbial that all dairymen were healthy and long-lived, and that no better reason could be assigned than that the constant evolution of ammoniacal gases counteracted malarias.[2]

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* Mr. Howard G. Eisaman, Federal-State Market Administrator for the New Orleans milk market, and officials of the Louisiana Milk Commission assisted the authors in making this study by making available official records for analysis. They also made valuable suggestions concerning market conditions. The New Orleans milk dealers kindly permitted the use of certain confidential information. Statistical information was also secured from the Dairymen's Protective League.

[1] The first steam railroad in Louisiana was built in 1830, between New Orleans and Milneburg, a distance of about five miles. This was the Pontchartrain Railroad which operated continuously from 1830 to 1932. (See Ball, C. W., "Two Hundred and Fifteen Years of Sanitation in New Orleans," *Vox Sanitatis,* Vol. II, No. 1, November, 1933, p. 19.)

[2] Ball, C. W., *Ibid,* p. 29.

The increase in the population of New Orleans during the last 100 years or more has had a pronounced effect upon dairying in the area. In 1838 one of the first health and sanitary measures affecting milk and milk production in the South was promulgated by the City Board of Health. Cow barns were prohibited within certain areas and each milk peddler was required to display an assigned number on his wagons. In 1873, a strenuous effort to further extend the area in which producers could not operate dairies was defeated.[3] The need for additional regulation during this period is shown by the report of a dairy inspector in 1870. This report disclosed that of twenty specimens of milk examined, practically every one had been adulterated with from 10 to 60 per cent of water.

However, as the city increased in population and sanitary measures began to be enforced somewhat better, dairymen had little choice as to the new location of their dairies when forced to move from New Orleans. During this early period, they were practically compelled to move northwest, along the east bank of the Mississippi River. The land south of the city was largely unreclaimed marshland, while a short distance to the east was Lake Borgne. The Mississippi River, with no bridges, was a natural boundary on the west, and Lake Pontchartrain on the north prevented any development in that direction. At one time a large part of the milk supply of New Orleans originated in the LaPlace and Kenner area, which is approximately 28 miles from the city.

Increasing land values, caused by intensive truck farming, as well as the demand for more milk, resulted in a further shift, beginning about 1890. This was largely to relatively inexpensive land located in Tangipahoa and adjoining parishes. The relative importance of this area has been gradually increasing since that time, so that in recent years most of New Orleans' milk supply has originated there.

Rapid changes have taken place in the New Orleans milk market in the past two years. The demand for more effective sanitary regulations on the part of consumers has resulted in increased power being given to the Board of Health to control the conditions under which fluid milk is produced and marketed. The federal and state governments have entered the market with a milk marketing order in an attempt to effect more orderly marketing conditions. The milk producers' cooperative has tended to become more important as the official voice of nearly 2,000 milk producers. Fifteen relief milk stations have been established throughout the city by the federal government, and approximately 12,000 quarts of fluid milk have been sold daily to relief clients at a price of 5 cent per quart. Milk producers, under the terms of the marketing order, have been receiving a price based upon the total utilization of fluid milk, as ascertained by government audit at the end of each month. Prices paid producers have been in excess of $2.00 per hundredweight for the entire market since the parallel Federal and State orders have been in effect.

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[3] Ball, C. W., *Ibid*, pp. 19-27.

Present Conditions in the Milkshed

The conditions under which fluid milk is produced at the present time vary greatly in different parts of the milkshed. Within the city limits of New Orleans there are 113 relatively small dairies where fluid milk is produced and sold direct to consumers. One hundred and seven of these dairies average less than two acres each in total land area, and have an average of 30 milk cows. Abandoned graveyards, vacant lots, canal and river banks are the principal sources of pasturage. No attempt is usually made to produce either replacements for the dairy herd or feed crops for the milk cows. Frequently as many as ten different dairy herds will be found using the same abandoned graveyard as a pasture. The cheapest and most widely used dairy feed is brewery mash, which is purchased from the breweries located in the area. The conditions under which fluid milk is produced by these dairymen resemble a manufacturing process more than normal dairy farming.

In that part of the supply area more distant from the city, the production of fluid milk approaches the normal methods of dairy farming found in other regions. The size of the farms becomes larger and the number of dairy animals per herd smaller.

The city of New Orleans draws its fluid milk supply from 18 parishes and counties located in Louisiana and Mississippi as shown in the figure on the cover page and in Table 1. The outer limits of the shippers' milkshed are about 120 miles from the city. Within this area are located 13 receiving stations to which milk is delivered from more than 2,000 producers. About 265 producer-distributors living within 30 miles of the

TABLE 1. New Orleans Milk Supply[1], Number of Herds and Cows, by State and Parish or County, October 1939—September, 1940.

State and parish or county	Volume of milk (pounds)	Per cent handled	Number of herds	Average No. cows per herd	Number of cows
Louisiana:					
Orleans	1,207,629	12.4	113	30	3,424
St. Bernard and Plaquemines	352,006	3.6	25	39	965
Jefferson and St. Charles	2,323,978	23.8	127	50	6,350
Tangipahoa	3,024,013	30.9	954	13	12,409
Washington	1,371,921	13.0	377	12	4,533
East Feliciana	341,829	3.5	119	22	2,616
Total	8,621,376	88.2	1,715	18	30,297
Mississippi					
Pearl River	456,186	4.7	128	14	1,802
Walthall	241,012	2.5	158	7	1,107
Pike	450,877	4.6	182	8	1,456
Total	1,148,076	11.8	468	9	4,365
Grand Total	9,769,451	100.0	2,183	16	34,662

TABLE 2. MONTHLY RECEIPTS OF FLUID MILK AT NEW ORLEANS FROM SHIPPERS, BY CLASSES, OCTOBER, 1939, TO AUGUST, 1941.

YEAR AND MONTH	Total Pounds of Milk	PERCENTAGE OF DISTRIBUTION BY CLASSES				
		Class I	Relief	Class II	Class III	Total
1939:						
October	5,681,792	81.0	...	17.1	1.9	100.0
November	5,423,590	85.6	...	9.4	5.0	100.0
December	5,628,723	82.0	...	13.0	5.0	100.0
1940:						
January	5,464,228	84.3	...	10.0	5.7	100.0
February	5,140,124	88.4	...	9.0	2.6	100.0
March	6,016,833	81.2	...	14.1	4.7	100.0
April	6,769,979	65.4	...	21.4	13.2	100.0
May	6,855,181	74.1	1.6	8.5	15.8	100.0
June	6,602,630	68.2	7.2	9.2	15.4	100.0
July	6,863,025	65.7	8.2	10.2	15.9	100.0
August	7,058,067	68.5	8.1	9.3	14.1	100.0
September	6,994.333	72.2	6.6	7.7	13.5	100.0
October	7,411,916	72.9	7.0	3.1	17.0	100.0
November	6,825,303	74.8	6.9	3.3	15.0	100.0
December	6,552,597	76.9	7.2	2.5	13.4	100.0
1941:						
January	6,897,952	75.4	6.7	3.0	14.9	100.0
February	6,499,011	74.4	6.5	7.4	11.7	100.0
March	7,681,502	69.9	6.5	7.6	16.0	100.0
April	9,079,824	52.6	5.5	14.9	27.0	100.0
May	10,194,317	48.4	5.6	14.1	31.9	100.0
June	10,039,279	46.5	6.0	12.7	34.8	100.0
July	10,651,128	48.6	5.5	12.0	33.9	100.0
August	10,283,371	48.3	6.0	11.5	34.2	100.0

market deliver their milk daily to consumers in the city. Approximately 36 per cent of the fluid milk consumed in the market comes from producer-distributors, and the remainder from shippers who are located more than 30 miles from the city. Nearly 12 per cent of the supply originates in Mississippi.

Milk Supplies from Shippers

Beginning with October, 1939, when the present Federal-State milk marketing order became effective in New Orleans, figures are available for each month showing the total receipts of milk from approved shippers by months and by classes of milk. Table 2 shows the total receipts of milk in pounds each month, together with the percentage used in each class.[4]

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[4] During the period covered by the table there were certain changes in the definition of the various classes of milk. However, in general, Class I milk consists of all milk sold at competitive prices in fluid form as regular, certified, special, or flavored milk, buttermilk or skim milk. Relief milk consists of milk sold in fluid form at the special price of 5 cents per quart in connection with the relief program of the Federal government. Class II consists of milk sold as fluid cream and creamed cheese. Prior to May 1, 1940, Class II milk included ice cream. Since that time milk used for ice cream has been included in Class III. Class III milk consists of all milk not included in the other classes.

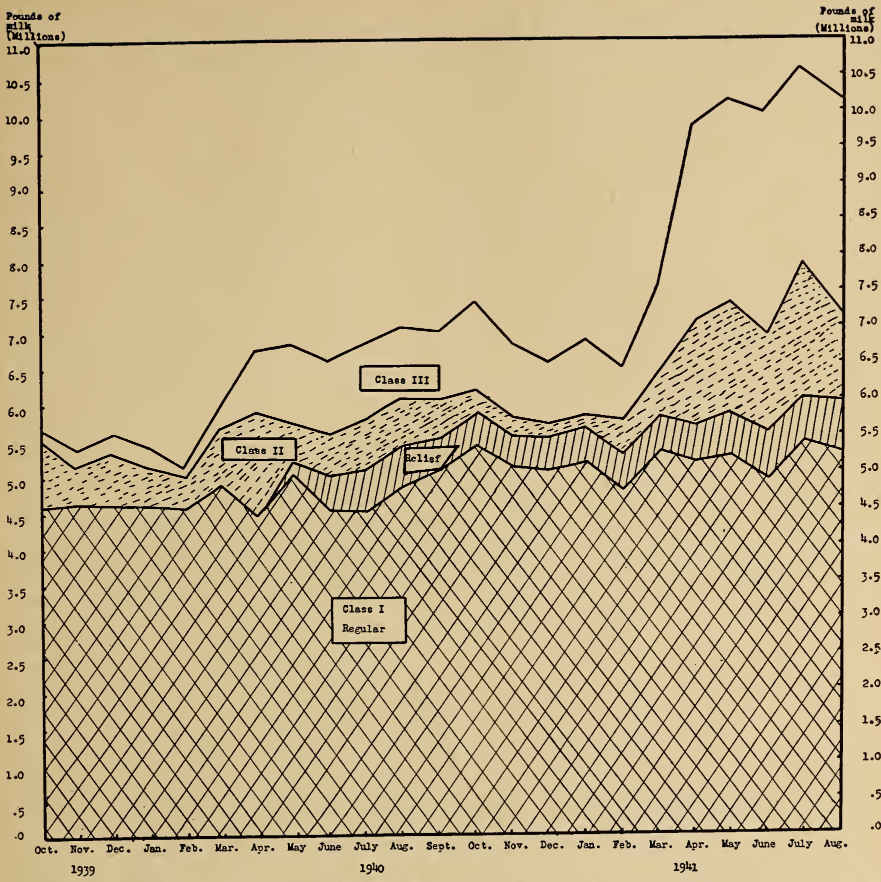

FIGURE 1. Receipts of Fluid Milk at New Orleans from Shippers, by Classes of Milk, October, 1939, to May, 1941

The total supply of milk received from shippers trended upward, except for seasonal fluctuations (see Figure 1). The average number of pounds of milk reaching the market during the months of January, February, and March, 1941, was 27 per cent larger than the amount received during the same months in 1940. The percentage distribution between classes changed somewhat during the period. The percentage used as Class I has been considerably less since April, 1940, than it was prior to that time. The proportion used as relief milk has generally been lower in 1941 than it was in 1940. The percentage used in Class I is of particular importance to milk producers because the price received for such milk is considerably higher than that received for other classes.

The largest volume of milk normally reaches the market during the months of April, May and June. During the past three years the production of milk in April has averaged 113.4 per cent of the annual monthly average, in May 117.4 per cent, and in June 116.9 per cent. De-

TABLE 3. DISTRIBUTION OF MONTHLY RECEIPTS OF MILK FROM SHIPPERS, BY PARISHES,[1] OCTOBER, 1939, TO SEPTEMBER, 1940, NEW ORLEANS MILK MARKET.

MONTH	Total Milk Receipts (1,000 pounds)	PER CENT OF RECEIPTS OF MILK BY PARISHES									
		LOUISIANA					MISSISSIPPI				
		Tangipahoa	Washington	East Feliciana	Other[2]	Total	Pearl River	Pike	Walthall	Total	Grand Total
1939:											
October	5,682	45.1	20.9	5.6	10.6	82.2	5.8	7.4	4.6	17.8	100.0
November	5,424	44.5	20.5	5.8	10.7	81.5	6.7	7.2	4.6	18.5	100.0
December	5,629	44.9	21.1	5.9	8.9	80.8	7.1	7.3	4.8	19.2	100.0
1940:											
January	5,464	45.9	20.9	5.5	8.2	80.5	7.3	7.4	4.8	19.5	100.0
February	5,140	46.4	20.6	5.8	7.9	80.7	7.2	7.5	4.6	19.3	100.0
March	6,017	47.9	20.8	5.6	6.8	81.1	7.3	6.9	4.7	18.9	100.0
April	6,770	46.9	21.5	5.5	7.7	81.6	7.8	7.4	3.2	18.4	100.0
May	6,855	44.6	22.7	5.0	8.7	81.0	8.2	7.5	3.3	19.0	100.0
June	6,603	47.8	22.5	5.5	5.5	81.3	7.9	7.3	3.5	18.7	100.0
July	6,836	46.5	24.1	5.3	5.0	80.9	7.8	8.4	2.9	19.1	100.0
August	7,058	45.6	24.2	5.2	8.1	83.1	7.4	6.7	2.8	16.9	100.0
September	6,994	45.6	23.8	5.6	7.8	82.8	7.1	6.5	3.6	17.2	100.0
TOTAL	74,499	46.0	22.0	5.5	8.0	81.5	7.3	7.3	3.9	18.5	100.0

[1] The data represent milk delivered from receiving stations in each parish or county. In some cases this differs from the parish or county in which the milk was produced.

[2] This was mostly milk delivered directly to plants in New Orleans.

cember, January and February have been months of comparatively low production. Production in December has averaged about 95 per cent of the monthly average, in January about 91 per cent, and in February 86 per cent. The monthly variation each year is usually somewhat greater than these averages.

The milk supplied by the shippers is collected at 13 receiving or cooling stations from which it is transported to the city. In addition certain dealers receive some milk directly in New Orleans. Table 3 shows the receipts of milk from shippers[5] by parishes or counties, according to the location of the receiving stations, for the period from October, 1939, to September, 1940. An average of 81.5 per cent of the milk originated in Louisiana. More than two-thirds of the total came from Tangipahoa and Washington parishes. Most of the milk from Mississippi came from Pearl River and Pike counties. There were no material changes during the year in the proportion coming from different parts of the milkshed, although the total supply increased considerably. The concentration of milk supplies from Tangipahoa parish is greatest in the northern part of the parish.

During the year there were approximately 2,200 farmers who shipped milk to New Orleans. Not all of these were active shippers at any one

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[5] Milk produced by producer-distributors is not included.

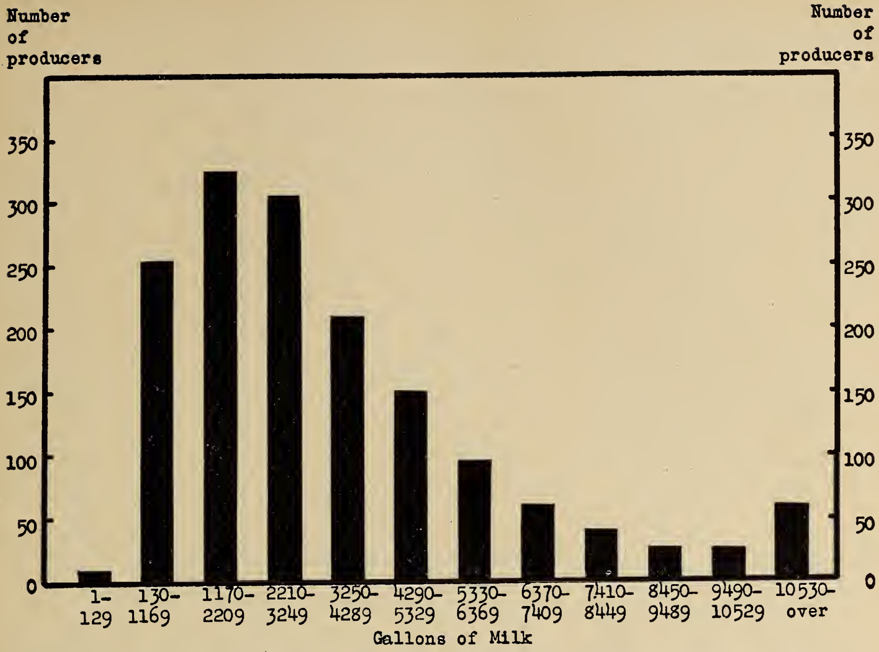

FIGURE 2. Distribution of Producers Shipping Milk to New Orleans According to Average Monthly Volume Shipped, October, 1939, to September, 1940.

time, but between 1,500 and 1,600 actually shipped some milk each month. The distribution of these shippers according to their average daily shipments to the New Orleans market is shown in Figure 2. The largest number of producers shipped between 1,170 and 2,209 pounds of milk each per month. This is equivalent to a herd of from 4 to 8 cows, if each cow produced an average of one gallon of milk per day. Of course, the actual production per cow varied greatly so that the size of the herds can be measured only approximately in this way.

Forty-one per cent of the producers shipped an average of less than 3,250 pounds of milk per month. These producers supplied approximately 27 per cent of the milk coming from shippers. At the other extreme, there were 0.8 per cent of the shippers who delivered an average of 10,530 pounds of milk per month. These few shippers supplied 15.5 per cent of the total volume of milk coming from shippers. Thus while the typical size of herd of the shippers is small, there are a few large producers who supply an appreciable proportion of the total amount of milk reaching the market.

Milk Supplies from Producer-Distributors

The available information relative to producer-distributors relates almost entirely to the period from July, 1938, to June, 1939. During that year there were approximately 265 producer-distributors serving the New

TABLE 4. SIZE OF BUSINESS AND MISCELLANEOUS INFORMATION CONCERNING PRODUCER-DISTRIBUTORS OF MILK, NEW ORLEANS, 1938-39.

SIZE OF BUSINESS	Orleans	St. Bernard and Plaquemines	Jefferson and St. Charles	All producer-distributors
Number of operators	113	25	127	265
Average number of acres in farm	9.5	57.7	55.7	36.2
Average miles from market	5.1	9.4	12.6	9.1
Average number of cows:				
In herd	30	39	50	41
Milked daily	22	32	37	30
Average number gallons of milk:				
Produced daily	39.6	53.2	67.0	54.0
Purchased daily	1.1	0.5	2.7	1.9
Per cent of supply purchased	2.7	0.9	3.9	3.2
Price per gallon milk purchased[1]	23.2	24.8	24.1	24.1
Milk pasteurized:				
Average number gallons	1.2	0.0	16.1	8.3
Per cent of total	2.9	0.0	23.1	14.9

[1] Price in cents per gallon. Only 43 farms in Orleans, 10 in St. Bernard and Plaquemines, and 31 in Jefferson and St. Charles parishes reported these prices.

Orleans market. There were 113 whose herds were located in Orleans Parish, 127 in Jefferson and St. Charles parishes, and 25 in St. Bernard and Plaquemines parishes.

Table 4 contains some figures relative to the size of business of these producer-distributors. In general the dairymen in Orleans Parish were operating on a smaller scale than those in the other parishes. This was particularly true so far as the average size of farms was concerned, but the number of cows per herd and the amount of milk produced daily were also materially lower in Orleans. This appears to be largely the result of higher land values near the city and the fact that the dairies are located closer to the customers so that smaller loads may be handled without encountering prohibitively high delivery costs.

Some of the producer-distributors purchase small amounts of milk in addition to what they themselves produce. An average of 3.2 per cent of the milk distributed by these dairymen was purchased from other producers. Such purchases are usually made to provide enough milk for the customers whenever the dairyman's own production is insufficient.

Most of the producer-distributors handle only unpasteurized milk. However, 22 operated pasteurizers and usually distributed both pasteurized and unpasteurized milk according to the desires of their customers. A total of nearly 15 per cent of the milk handled by producer-distributors was pasteurized. Most of the pasteurizing was done by the larger operators in Jefferson and St. Charles parishes.

The number of producer-distributors with various sizes of business is shown in Table 5. There were 112 producer-distributors, or 42 per cent of the total number, each of whom handled less than 40 gallons of milk

TABLE 5. DISTRIBUTION OF PRODUCER-DISTRIBUTORS OF MILK ACCORDING TO SIZE OF BUSINESS, NEW ORLEANS, 1938-1939.

VOLUME HANDLED PER DAY (*gallons*)	Number of producer-distributors	Average number of acres in farm	AVERAGE NUMBER OF COWS		Average number of miles from market	AVERAGE DAILY GALLONS OF MILK		Per cent of milk purchased	Average number gallons pasteurized daily	Per cent of total supply pasteurized
			In herd	Milked daily		Pro-duced	Pur-chased			
Under 20	22	1.6	11	8	6.4	13.6	0.2	1.5	0.0	0.0
20-39.9	90	7.9	24	18	8.3	30.7	0.4	1.3	0.0	0.0
40-59.9	63	24.6	38	28	8.7	49.2	0.3	0.6	0.1	*
60-79.9	43	29.3	49	37	10.5	66.7	1.2	1.8	1.5	2.2
80-99.9	25	35.4	58	45	9.9	85.2	3.2	3.6	10.8	12.2
100-149.9	14	111.5	95	68	11.6	117.2	7.1	5.7	42.5	34.2
150-over	8	447.9	140	98	15.6	188.7	26.7	12.4	151.3	70.2
TOTAL	265	36.2	41	30	9.1	54.0	1.8	3.2	8.3	14.9

*Less than 0.05 per cent.

per day. This group furnished only 21 per cent of the total supply of milk coming from producer-distributors. At the other extreme, there were 22 producer-distributors, or 8 per cent of the total number, each of whom handled more than 100 gallons of milk per day. These dairymen contributed 23 per cent of the total supply coming from producer-distributors, or slightly more than the 112 smallest operators.

Table 5 also shows that the larger operators purchased a larger proportion of the supply of milk they handled than did the smaller operators. Purchases, however, were not very important except for the few largest operators who handled 150 gallons of milk or more per day. Some of these might almost have been classified as commercial handlers of milk rather than as producer-distributors, although they all produced part of the milk they handled.

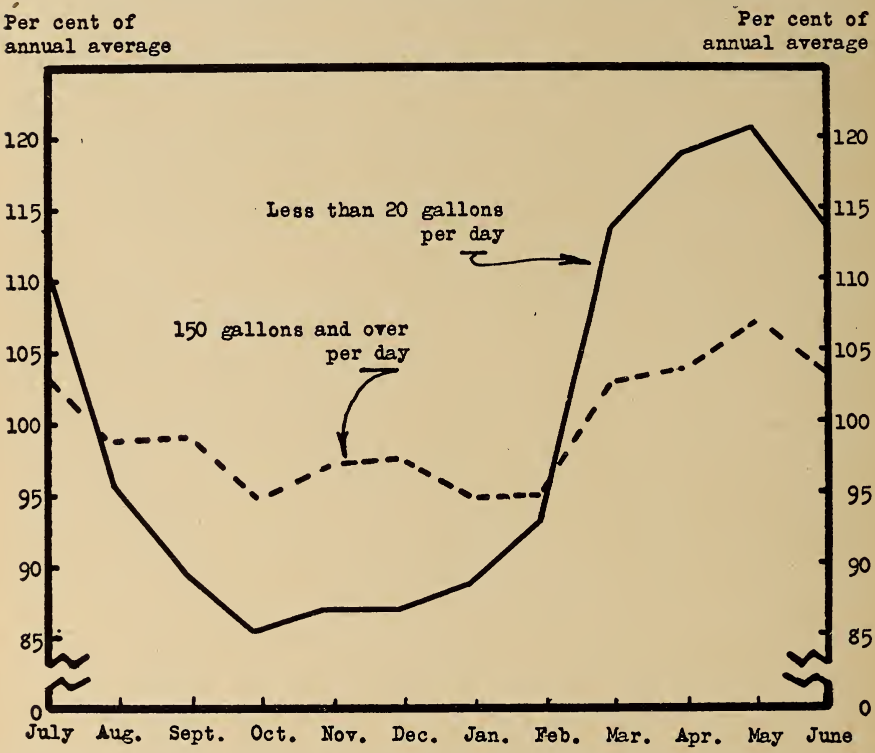

FIGURE 3. Seasonal Trends in the Amount of Milk Handled by Large and by Small Producer-Distributors of Milk in New Orleans, 1938-39.

No appreciable amount of milk was pasteurized by the small producer-distributors who produced less than 80 gallons of milk per day. Apparently, a considerable volume is necessary before even the smallest sized pasteurizers can be used profitably. Some of the largest operators pasteurized nearly all of the milk they handled. Also, some of these larger concerns attempted to market a special quality of milk for which they charged higher prices than did their competitors.

The amount of milk handled by producer-distributors shows a distinct seasonal movement. The volume was relatively small from August to February and relatively large during the remainder of the year. These seasonal movements followed approximately the same pattern for all sizes of operators, but the amplitude of the swings was much greater for small producer-distributors than for large ones. This is shown in Figure 3. The precise reason why the large operators maintained a more even supply of milk throughout the year is not clear. Perhaps they were more skillful operators, and thus were able to supply their customers' demand for fresh milk throughout the year, with less surplus at certain seasons than the smaller-sized operators produced.

Price Plan Used in the Market

No other feature of the New Orleans milk market causes as much discussion, disagreement, and at times open strife, as the prices which farmers are to receive for fluid milk. The primary purpose of the Dairymen's Protective League since its organization has been to bargain with milk distributors, and during the last two years with the Federal-State Milk Market Administration, concerning prices.

The prices which attract the most public notice are those paid to milk shippers by city distributors. However, the prices which producer-distributors receive for their milk are no less important to the market as a whole, because competition between the two groups of dairymen tends to limit the price each group can secure.

Before the advent of the Federal-State milk marketing order in October, 1939, the milk shippers had bargained, more or less collectively, with the New Orleans milk distributors concerning the prices they were to receive for milk. Various agreements were in effect at different times, although there was always much uncertainty in the minds of many shippers as to whether or not certain dealers were complying with the current agreement as to prices. This resulted in suspicion, ill will, and the frequent breakdown of agreements. Unquestionably this situation was a contributing factor to the demand for some type of control by the Federal or State governments.

The price plan inaugurated with the Federal-State milk marketing order in October, 1939, was a rather complicated affair, although not more so than some of those previously tried in the market. The plan was of the type commonly called an individual handler pool. That is, each individual handler in the New Orleans market paid a price to his shippers for milk based primarily on the use that the handler made of the milk he purchased. Each person shipping to a given handler would receive the same price for milk in any given pay period, after adjustments had been made for variations in the butterfat content of the milk and in the distance of the receiving station from New Orleans. Prices received by persons shipping to different handlers could be and usually were different because handlers used different proportions of their milk receipts for Class I, Relief, Class II, and Class III purposes.

Shippers' Prices for Milk

The price for Class I milk originally set by the Federal-State milk marketing agreement was $2.32 per hundredweight. This was for milk containing 4 per cent butterfat and delivered to the handler within a zone from 61 to 70 miles distant from New Orleans. Premiums were paid for milk containing more than 4 per cent butterfat and discounts were allowed for milk with a lower butterfat content. Likewise, the price was higher if the milk was delivered to the distributor at a point closer to the city than the base zone, and lower if the delivery was at a more distant point. The base price of Class I milk was changed on April 1, 1941, to $2.40 per hundredweight during April, May, June, and July, and to $2.75 per hundredweight during the other eight months of each year. The price for relief milk was set at $2.00 per hundredweight throughout the year.

The price of Class II milk was originally set at $1.85 per hundredweight and has remained unchanged to the present time.

The price of Class III milk set by the Federal-State order has always been a "formula" price based on the market price of butter in the United States. The exact formula used was changed on April 1, 1941, in such a way as to increase somewhat the prices received by farmers for this milk, although the price still varies with market variations in the price of butter.

It is apparent that under this scheme, all dairymen shipping milk to New Orleans do not receive the same price for milk during the same month or pay period. Three factors cause this price to be different for different producers. These are: (1) the varying proportions of milk used for Class I, Relief, Class II, and Class III purposes by different handlers; (2) variations in the butterfat content of milk produced by different farmers; (3) variations in the distance from New Orleans of the receiving stations at which producers deliver their milk.

Price variations caused by the second of these factors are largely the result of the individual and breed characteristics of the various herds. Those farmers who produce milk with the highest butterfat content do not necessarily make the most profit, since the cost of producing such milk may be greater than it is for milk containing a smaller percentage of butterfat.

Variations in price resulting from the third factor are relatively permanent once the location of a dairy farm is established. Ordinarily the only thing an individual dairyman could do to change his situation in this respect would be to move to another farm. In some cases, however, dairymen, by changing the receiving station to which they deliver their milk, can change the distance zone for which they are paid. Of course if this involves a longer haul from the farm to the receiving station, the increased cost might offset any increase in price that would be gained. In any event, price differences because of varying distances from market appear entirely logical and are not a cause of dissatisfaction on the part of farmers or dealers.

The situation with respect to price variations caused by the varying proportions of milk used in each class by different handlers is more serious from the point of view of the farmers. If a farmer happens to be selling his milk to a handler who uses most of it for Class I purposes, he receives a higher price than he would get if the handler used a smaller proportion for such purposes. The differences between handlers in the proportions used as Class I milk are frequently quite substantial, and the resulting differences in the price of milk received by farmers are sufficient to make the dairy enterprise materially more profitable for some farmers than for others.

The Federal-State Milk Market Administrator's office calculates for each pay period a uniform price for the market based on milk delivered to handlers in the 61 to 70 mile zone. A separate price is calculated for milk containing 4 per cent butterfat and for milk of the actual average butterfat content delivered. These prices for each month from October, 1939, to August, 1941, together with the class prices for milk, are shown in Table 6. The variations in the prices from month to month reflect changes in the class prices set by the Administrative Order, changes in the price of Class III milk resulting from changes in the market price of butter and changes in the average proportion of milk used in various classes by the handlers. In spite of the rising prices for Class I milk, the "uniform price" for the market has shown no upward trend, although it was relatively high in August, 1941. The price has been higher during the winter months than at other times; but it has declined during the summer months. Apparently the increasing proportion of milk used in lower price classes has just about offset the increases in the price of Class I milk.[6]

A comparison of the "uniform prices" paid by individual handlers by months is shown in Table 7. These prices represent what would be paid for 4 per cent milk delivered in the 61 to 70 mile zone. The only reason for the variations in price in any one month is the different proportions of their supply of milk used for different class purposes by the various distributors. The importance of these differences in price can be determined from the data given in the table. The difference between the highest and lowest price paid by this group of distributors varies from 7.0 cents per 100 pounds of milk in August, 1940, to 23.9 cents in August,

---

[6] However, it is true that the total amount of money received by milk shippers has increased during this period, because of the increased production. This is shown in the last column of Table 6. For instance, the shippers' receipts for milk were nearly 60 per cent larger for the months of June, July, and August, 1941, than they were for the same months in 1940. This does not mean that the average dairyman received 60 per cent more for his milk during these months in 1941 than he did in 1940. Part of the increased production came from new producers, although the exact amount cannot be determined from available data.

TABLE 6. Prices Per 100 Pounds to be Paid Farmers for Milk According to the Announcements of the Federal-State Milk Market Administrator, by Months, October, 1939, to August, 1941.

Year and month	Basic price specified in the market order[1]				Uniform price for the market [2]		Amount farmers received for milk[3] (*Thousand dollars*)
	Class I	Relief	Class II	Class III	Four per cent butterfat	Actual butterfat content	
1939:							
October....	$2.32	....	$1.85	$1.37	$2.19	....	...
November..	2.32	....	1.85	1.43	2.56	2.55	138
December..	2.32	....	1.85	....	2.48	2.61	147
1940:							
January....	2.32	....	1.85	1.50	2.21	2.32	127
February...	2.32	....	1.85	1.40	2.24	2.32	119
March.....	2.32	....	1.85	1.35	2.14	2.33	140
April.......	2.32	....	1.85	1.28	2.04	2.23	151
May.......	2.32	2.00	1.85	1.42	2.14	2.29	157
June.......	2.32	2.00	1.85	1.41	2.10	2.23	147
July.......	2.32	2.00	1.85	1.42	2.09	2.23	153
August.....	2.32	2.00	1.85	1.44	2.11	2.25	159
September..	2.32	2.00	1.85	1.46	2.14	2.35	164
October....	2.32	2.00	1.85	1.54	2.14	2.46	182
November..	2.32	2.00	1.85	1.66	2.17	2.56	175
December..	2.32	2.00	1.85	1.73	2.19	2.61	171
1941:							
January....	2.32	2.00	1.85	1.56	2.18	2.50	172
February...	2.32	2.00	1.85	1.56	2.18	2.45	159
March.....	2.32	2.00	1.85	1.59	2.13	2.38	183
April.......	2.40	2.00	1.85	1.54	2.13	2.31	210
May.......	2.40	2.00	1.85	1.63	2.09	2.28	243
June.......	2.40	2.00	1.85	1.66	2.09	2.27	228
July.......	2.40	2.00	1.85	1.61	2.08	2.24	239
August.....	2.75	2.00	1.85	1.76	2.31	2.53	260

[1] For milk containing 4 per cent butterfat delivered in the 61 to 70 mile zone.

[2] The average ior all handlers on the basis of milk delivered in the 61 to 70 mile zone.

[3] These amounts are estimated from the uniform price for milk (actual butterfat content), which is an f.o.b. price for the 61-70 mile zone. These amounts would therefore differ slightly from the actual amounts received by farmers.

1941. The smallest of these differences was equal to 3.31 per cent of the lowest price paid for milk in that month, and the largest to 10.72 per cent.

The high and low prices for each month are set in boldface in Table 7. It is apparent that while there was considerable uniformity from month to month in the relative price position of the various distributors, there was some shifting. This shifting makes it more difficult for a dairyman to know whether or not he is selling his milk to the dealer with the highest price. Of course, many producers are not in a position to shift from one dealer to another. There may be only one dealer buying milk in their territory or the other dealers may refuse to accept their milk. Nevertheless, the importance of the problem to the farmers is obvious from the size of the price variations that exist.

TABLE 7. UNIFORM PRICES PAID PRODUCERS BY PRINCIPAL DISTRIBUTORS AT SELECTED PLANTS FOR MILK CONTAINING 4 PER CENT BUTTERFAT, 61 TO 70 MILE ZONE BASIS, NEW ORLEANS MARKET.

DISTRIBUTOR	UNIFORM PRICE PER 100 POUNDS—4 PER CENT MILK—61 TO 70 MILE ZONE														
	1940							1941							
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
1	2.095	**2.061**	**2.113**	**2.125**	**2.122**	2.173	2.217	2.177	**2.168**	**2.120**	2.093	2.045	2.048	**2.012**	2.234
2	2.091	2.125	2.133	2.176	2.190	2.212	2.203	2.170	2.212	2.146	**2.064**	**2.034**	**2.027**	2.093	2.261
3	**2.020**	2.085	2.151	2.184	2.207	**2.169**	**2.106**	**2.060**	2.176	2.154	2.100	2.116	2.062	2.195	2.345
4	2.110	2.135	2.144	2.180	2.177	2.177	2.257	2.240	2.221	2.189	2.196	2.130	2.153	2.159	2.377
5	2.090	2.157	2.156	2.184	2.170	2.209	2.234	2.202	2.219	2.223	2.186	2.160	2.151	2.142	2.367
6	2.185	2.153	2.146	2.193	2.207	2.198	2.166	2.153	**2.241**	**2.261**	**2.288**	2.147	**2.166**	**2.205**	**2.468**
7	2.172	2.148	2.163	2.181	2.204	2.227	**2.273**	**2.250**	2.234	2.185	2.233	**2.200**	2.105	2.124	**2.229**
8	**2.196**	**2.197**	**2.183**	**2.207**	**2.213**	**2.252**	2.247	2.225	2.195	2.194	2.161	2.124	2.107	2.063	2.319
Difference high and low prices	.174	.136	.070	.082	.091	.083	.167	.190	.073	.141	.224	.166	.139	.193	.239

Producer-Distributors' Prices for Milk

There is no regulation, either by the Federal or State government or any other organization, of the prices which producer-distributors receive for milk. Since this milk is sold to consumers and retail dealers, such as stores, restaurants, and hotels, the prices received by the producer-distributors are considerably higher than those received by shippers. However, an important part of the costs incurred by producer-distributors is that for bottling milk and delivering it to their customers. Since shippers do not incur such costs, it is impossible to determine from the price data whether or not producer-distributors secure larger net returns for their milk than do shippers.

The prices actually received by producer-distributors in 1938-39 are shown in Table 8. Retail prices represent sales made to consumers, and wholesale prices sales to retail dealers such as stores, restaurants, and hotels. There were rather large variations in the prices received. However, it is apparent that wholesale prices were generally lower than retail prices, and within each group, prices for bulk milk were lowest and for pasteurized milk highest. The price for raw milk sold at retail mostly varied from 10 to 13 cents per quart, as compared with 8 and 9 cents for milk sold wholesale. This is an average difference of about 3 cents per quart. This difference is largely a result of the fact that it is cheaper to deliver milk in relatively large quantities to a few customers than it is in small quantities to many customers. Prices for bulk milk, most of which is sold wholesale, averaged about 1.5 cents per quart lower than the prices in quart containers. Prices for pasteurized milk averaged somewhat higher than those for raw milk, but were relatively unimportant because of the small number of producer-distributors who handled such milk.

Distribution Within the City

No detailed analysis of the problems connected with distribution has been undertaken in connection with this study. However, a few outstanding circumstances concerning the distribution of milk in the New Orleans area which are important in relation to the total market situation will be discussed briefly.

While New Orleans does not have a compulsory pasteurization ordinance, the consumers have demanded pasteurized milk to such an extent that only about one-third of the supply reaches them as raw milk. The larger milk dealers distribute practically no unpasteurized milk. This is done almost wholly by the small producer-distributors. Judging from the prices shown in Table 8, it seems likely that raw milk is to a large extent used by people of low incomes who feel that they are not able to purchase pasteurized milk which is sold at a higher price.

The fluid milk supply is concentrated in the hands of a relatively few large distributors. Nearly two-thirds of the total supply of milk reaching

TABLE 8. Retail and Wholesale Prices of Milk Sold by Producer-Distributors in New Orleans, 1938-39.

Price per quart[1] (cents)	Number of producer-distributors receiving each price					
	Retail Sales			Wholesale sales		
	Raw	Pasteurized	Bulk	Raw	Pasteurized	Bulk
4-8	...	...	...	1	...	...
5.75	...	...	...	...	...	1
6.25	...	...	1	...	...	1
6.75	...	...	...	...	...	3
7	...	...	2	...	...	16
6.75-7.5	...	...	...	...	...	1
7.25	...	...	...	...	...	5
7.5	...	...	4	...	...	41
7-8	...	...	...	6	...	...
7.75	...	...	...	...	...	4
7.5-8	...	...	...	4	...	...
8	...	...	2	85	...	10
7-8-9	...	...	...	1	...	...
7.5-8-9	...	...	...	2	...	...
8-9	...	...	...	38	1	...
8.75	...	...	1	...	...	...
9	...	...	...	83	4	...
9-10	3	...	...	1	...	...
9.5-10	2	...	...	...	...	...
9-11	2	...	...	...	...	...
10	17	...	...	2	...	...
10-11	25	...	...	...	...	...
11	65	1	...	...	...	...
10-11-12	2	...	...	...	...	...
11-12	38	1	...	...	...	...
11-12-13	3	...	...	...	...	...
12	59	...	...	...	1	...
12-13	9	3	...	...	...	...
13	23	1	...	...	...	...
14	4	...	...	...	...	...
15	1	...	...	...	...	...
Number reporting	253	6	10	223	6	82
Number not reporting	12	259	255	42	259	183

[1] There are 46.5 quarts in 100 pounds of milk. Therefore, these prices can be converted to prices per 100 pounds by multiplying by 46.5.

the city in 1940 was handled by eight large distributors. A few small distributors and about 300 producer-distributors handled the remaining one-third, as shown in Table 9. These proportions did not vary greatly during the year, although there appears to have been a tendency for the large distributors to handle a larger proportion of the total milk supply during late summer and early fall months than during the remainder of the year.

There is a striking difference between the proportions of fluid milk (Class I) sold at wholesale and retail. The eight large distributors sold

TABLE 9. PROPORTION OF FLUID MILK IN NEW ORLEANS HANDLED BY LARGE AND SMALL DISTRIBUTORS AND PROPORTIONS SOLD AT WHOLESALE AND RETAIL, BY MONTHS, 1940.

MONTHS	TOTAL SUPPLY OF MILK		CLASS I REGULAR MILK			
	Per cent handled by eight large distributors	Per cent handled by other distributors	Distributors		Producer-distributors	
			Per cent sold wholesale	Per cent sold retail	Per cent sold wholesale	Per cent sold retail
January	60.0	40.0	87.0	13.0	32.2	67.8
February	61.0	39.0	86.7	13.3	32.7	67.3
March	65.3	34.7	80.4	19.6	31.3	68.7
April	64.4	35.6	86.4	13.6	34.6	65.4
May	64.5	35.5	87.1	12.9	37.2	62.8
June	62.9	37.1	88.1	11.9	36.4	63.6
July	64.1	35.9	86.9	13.1	39.3	60.7
August	69.1	30.9	87.6	12.4	38.9	61.1
September	65.7	34.3	87.2	12.8	38.7	61.3
October	68.3	31.7	86.8	13.2	37.3	62.7
November	63.0	37.0	86.7	13.3	36.4	63.6
December	63.2	36.8	87.2	12.8	32.2	67.8
Average	64.3	35.7	86.5	13.5	35.6	64.4

86.5 per cent of their fluid milk through wholesale outlets, as compared to 35.6 per cent sold through these outlets by producer-distributors. For the market as a whole, approximately two-thirds of the milk supply is sold through wholesale outlets. The proportions sold at wholesale were slightly larger in the summer months than during the remainder of the year.

The large proportion of milk marketed through wholesale channels indicates that the consumers in New Orleans purchase most of their milk supplies through grocery stores, meat markets, and similar outlets. There are two factors which, in the opinion of dealers and others familiar with the situation, account largely for the unusually high proportion of milk marketed at wholesale. They are the relatively low per capita income of the people in the city, and the high temperatures which prevail throughout most of the year. A large number of people do not have refrigeration facilities in their homes adequate to keep fresh milk in good condition for as long as one day. If fresh milk is purchased from a neighborhood store the family usually secures it just before the meal at which it is used, while home delivery might necessitate keeping milk for several hours before it is consumed. Thus in many cases it is probably more convenient to purchase the fresh milk from a store.

The fact that there is usually a price spread of two or three cents per quart between milk delivered at the home and that purchased in stores also furnishes a strong incentive to patronize stores. This is no doubt of particular importance to the lower income groups in the population.

Summary and Conclusions

Present unsettled economic conditions make it very difficult to appraise the future prospects of the New Orleans dairy industry. Both farmers and dealers are confronted with the problem of operating while costs for labor, feed, and other items are generally advancing.

Within the past two years there has been a very rapid increase in the total amount of fluid milk reaching the New Orleans market. At the same time there has been only a slight increase in the amount used for Class I purposes, while much larger quantities are being used for Class II and Class III purposes.

The prices received by farmers for Class II and Class III milk are materially lower than the prices received for Class I milk. Much of the effect of recent increases in Class I prices to shippers seems to have been offset by increases in the amount of milk entering Classes II and III. Consequently there has been little, if any, increase in the average price received by shippers for all of their milk.[7] Obviously, price increases for Class I milk, which encourage shippers to increase their production to the point where the average prices received for all milk remain approximately constant, tend to create burdensome surpluses for the entire market, without giving the shippers the benefit of higher prices.

Unduly high prices for Class I milk have other effects which are injurious to shippers. Whenever the dealers are required to increase the price they pay for Class I milk, they are likely to raise the prices charged consumers for fluid milk; otherwise their margins would be reduced. Such increases in prices almost certainly mean that consumers purchase less milk than they would at lower prices. This has the effect of reducing or limiting the amount of milk which shippers can sell as Class I.

The producer-distributors, who sell nearly all of their milk in fluid form, are benefited by raises in the retail prices charged by dealers. They can either raise their own prices accordingly or, what is more probable, raise their prices somewhat less than the amount of the increase made by the dealers and attempt to increase the volume of their business.

Because of the relationships just described it is important to the dairy farmers as well as to the dealers and the consumers that prices for fluid milk not be raised too high. Of course, such prices should fluctuate with economic conditions and the general level of all prices in the area concerned. During recent months prices have been rising throughout the United States. Under such circumstances milk prices can logically be expected to increase in conformity with the general trend.

The recent increase in the amount of Class III milk reaching the New Orleans market has increased the need for facilities to manufacture it into such products as butter, cheese, and condensed milk. Since New Orleans is situated in a deficit area for such products, they should find a ready local sale at prices competitive with shipped in products. However, it is doubtful whether dairymen in the New Orleans area can profitably continue to produce large quantities of milk for manufacturing purposes at such prices.

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[7] The data on which this statement is based make no allowance for the increase in Class I milk which occurred on February 1, 1942.

One feature of the price schedule for shippers' milk which became effective in April, 1941, may have some effect in changing the seasonal distribution of milk production in the New Orleans area. This is the higher price to be paid for Class I milk from August to March each year than will be given during the other four months of the year. Ordinarily milk production has been greatest during the summer months. The present price arrangement will encourage relatively greater production during the fall and winter months and less during the summer months than was true of previous price plans. Of course, it is not yet possible to measure the amount of influence this factor will have in changing the seasonal variations in production.

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LOUISIANA BULLETIN 340 MARCH, 1942

Rough Rice Marketing in Louisiana

By

C. A. BOONSTRA

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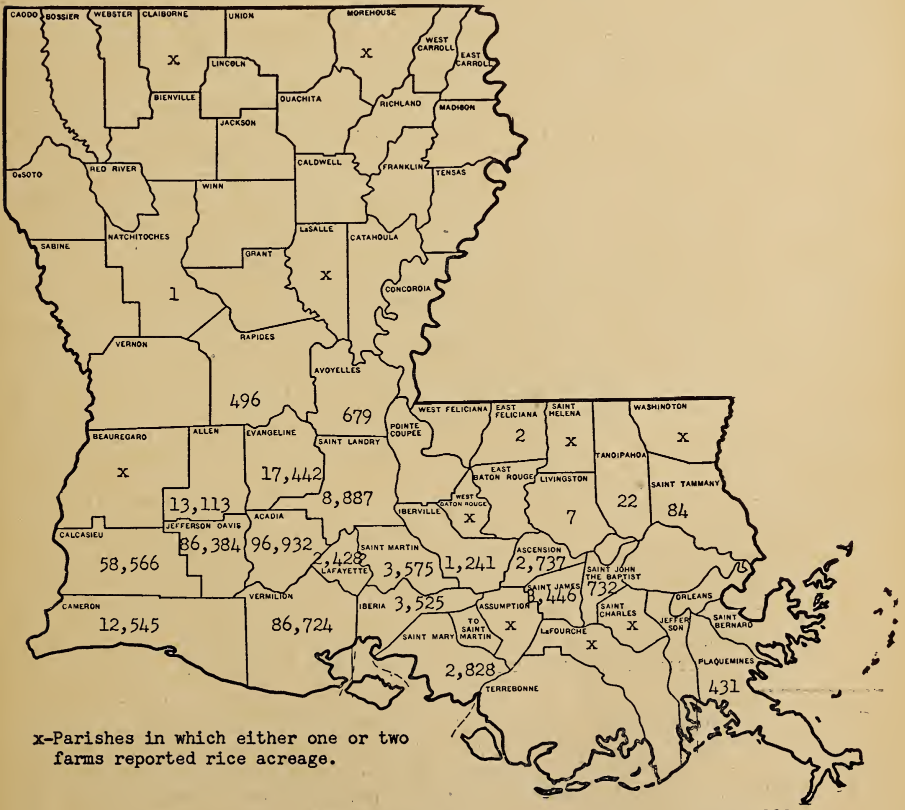
ROUGH RICE MARKETING IN LOUISIANA

By

C. A. Boonstra

INTRODUCTION

Problems involved in marketing rough rice, the second most important farm crop in Louisiana, have not in recent years received the general attention they merit. The specific objective of this bulletin is to clarify the present situation in regard to the marketing and processing of rough rice in Louisiana. It is hoped that, in further studies, attention can be devoted to problems involved in rice milling and in clean rice distribution, particularly with reference to price differentials paid by mills and the location of areas of heavy consumption of Louisiana rice. Several attempts at market improvement have been made by government, grower, and processor agencies, and within a few years, new or revised schemes will likely be added to those already injected into the market structure.



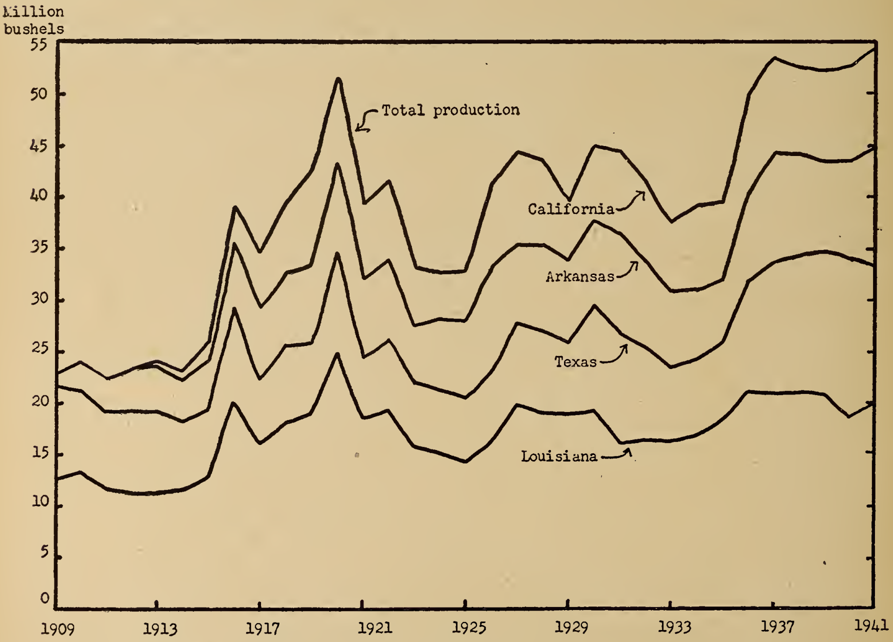
x-Parishes in which either one or two farms reported rice acreage.

FIGURE 1. Rice Acreage Reported in Louisiana Parishes for 1939, According to Census of Agriculture, 1940.

In Louisiana, the principal area of rice production is in the southwestern section of the state. In five parishes rice is the most important crop grown, although in each of ten additional parishes of the state there are 1,000 or more acres in rice. The principal minor areas of production are the Teche region just east of the broad southwestern prairies, and a section along the Mississippi River between Baton Rouge and New Orleans where rice is now restricted to a minor crop on sugar cane plantations.

INCREASING PRODUCTION OF RICE

Expanding acreage and rising average yields in the United States have caused a steady increase in rice production from 24 million bushels in 1909 to 53 million bushels in 1940.[1] Louisiana production rose from 13 million bushels in 1909 to an all-time peak of 25 million bushels in 1920, but in recent years has ranged somewhat above 20 million bushels. In recent years, Louisiana production has been decreasing in the minor producing areas while remaining stationary or increasing toward the western



Source: *Agricultural Statistics*, United States Department of Agriculture.

FIGURE 2. Production of Rough Rice in the United States Shown as a Cumulative Total of Important Producing States, 1909 to 1941.

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[1] In Louisiana, rough rice quantities are measured in terms of a barrel of 162 pounds, while in other areas a bushel of 45 pounds is more commonly used. Rice in Louisiana is generally stored in bags weighing from 180 to 200 pounds, while milled rice is handled in bags, or "pockets," weighing 100 pounds. These various measures are clumsy for statistical purposes, but efforts to simplify the terminology have met with little success in Louisiana.

TABLE 1. RICE ACREAGE ALLOTTED BY THE AGRICULTURAL ADJUSTMENT ADMINISTRATION IN LOUISIANA AND ACTUAL PLANTED ACRES, BY PARISHES, 1938-1941.

PARISH	1938		1939		1940		1941	
	Allotted acreage	Percentage of allotment planted	Allotted acreage	Percentage of allotment planted	Allotted acreage	Percentage of allotment planted	Allotted acreage	Percentage of allotment planted
	Acres	*Per cent*	*Acres*	*Per cent*	*Acres*	*Per cent*	*Acres*	*Per cent*
Acadia	99,516	123.6	99,718	104.7	99,528	103.1	98,223	113.5
Allen	11,817	110.0	13,089	113.2	13,089	123.4	12,920	149.1
Ascension	2,679	97.1	2,323	93.7	2,462	96.0	2,566	148.6
Assumption	1,144	78.7	798	96.4	1,136	91.4	1,180	84.3
Avoyelles	1.135	96.9	845	85.9	922	93.9	600	107.7
Calcasieu	36,744	206.8	51,583	127.2	56,666	120.7	57,268	153.3
Cameron	7,051	141.8	10,507	131.4	11,117	154.3	11,313	142.1
Evangeline	18,699	116.6	19,982	101.6	19,213	102.2	19,007	123.4
Iberia	3,927	122.2	3,940	98.9	4,197	92.3	3,873	111.3
Iberville	2,035	103.2	1,707	125.0	1,639	103.4	1,498	99.8
Jefferson Davis	78,822	123.4	86,346	119.0	88,700	116.2	89,429	126.9
Lafayette	5,576	132.7	5,982	102.4	5,955	97.9	5,956	111.5
Lafourche	520	76.9	430	74.4	438	89.0	400	93.0
Morehouse	....	.....	66	100.0	66	84.8	....	.....
Plaquemines	....	.....	....	.....	144	11.1	161	159.5
Rapides	....	.....	153	203.3	220	243.2	232	543.8
St. Charles	....	*	560	82.0	....	.....	434	212.9
St. James	4,972	96.5	4,512	94.1	4,771	97.9	4,684	127.0
St. John	997	100.3	905	98.1	987	109.0	968	112.3
St. Landry	11,694	107.7	11,619	95.9	11,562	95.4	11,533	111.1
St. Martin	3,405	117.5	3,644	96.3	3,399	94.8	3,246	126.9
St. Mary	3,279	128.1	3,314	122.5	3,121	121.3	3,319	147.7
St. Tammany	343	29.2	89	62.9	142	111.3	124	141.7
Vermilion	89,182	118.9	89,993	113.1	89,326	107.4	89,397	136.2
W. Baton Rouge	703	85.3	549	90.0	309	97.4	329	70.5
TOTAL	384,240	128.6	412,654	112.6	419,109	110.7	418,780	129.8

*300 acres planted.

Source: Agricultural Adjustment Administration, Baton Rouge, Louisiana. The percentage of allotment planted is taken from actual measurements of the A.A.A., and thus may be biased slightly downward from total plantings given in other official sources.

part of the state, as is evident in the tabulation of Agricultural Adjustment Administration data shown in Table 1. The greatest recent increases in production have occurred in Texas, where expanding acreage has been accompanied by steadily rising average yields per acre. Average yields in Texas have increased more than 15 bushels in the past 15 years, from less than 40 bushels per acre to 55 or more. Louisiana average yields have been fairly stable between 40 and 45 bushels per acre.

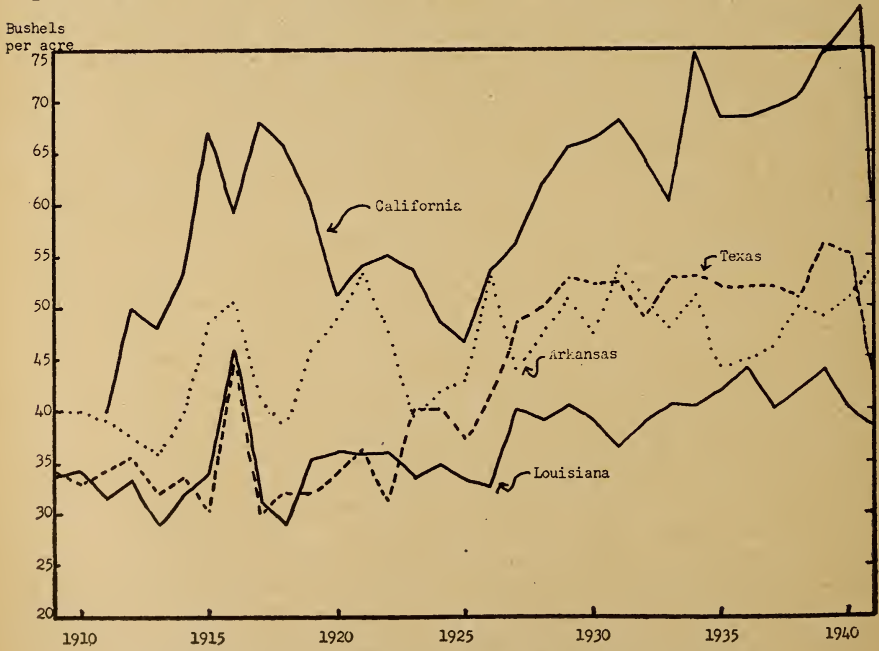
Table 2, assembled from annual estimates of rice crops prepared by the Rice Millers' Association, shows the approximate distribution by varieties of rice produced in Louisiana. By far the greatest proportion is Blue Rose, which has contributed about 70 per cent of the total production in recent years. This percentage has been declining because of a rapid rise in the production of Rexoro, a long-grain variety which contributed 13 per cent of the Louisiana crop in 1939 and surpassed Early Prolific in total production. Other varieties, including Fortuna, Nira, Lady Wright,

TABLE 2. PRODUCTION OF RICE, BY VARIETIES, IN LOUISIANA, 1929-1940.

VARIETY	PERCENTAGE OF TOTAL PRODUCTION											
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Blue Rose	77.1	73.5	73.7	77.2	84.3	81.4	74.7	74.6	74.7	71.9	70.8	72.3
Early Prolific	9.7	17.4	14.4	10.3	9.2	11.1	11.3	9.1	12.5	10.4	10.3	9.9
Rexoro	....	....	....	....	1.6	1.7	4.5	7.8	6.0	10.5	12.9	11.6
Fortuna	7.1	4.8	5.6	4.6	2.8	3.6	4.8	4.3	3.2	3.6	3.2	2.7
Nira	....	....	....	....	....	0.6	3.2	2.9	2.2	2.6	1.8	1.7
Lady Wright	1.8	1.5	1.4	0.9	0.3	0.2	0.2	0.5	0.4	0.3	0.1	0.1
Edith	3.3	2.1	3.9	4.0	1.5	1.3	1.2	0.4	0.4	0.1	0.2	....
Japan	0.7	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.5	0.6	1.6
Other Varieties	0.4	0.3	1.0	....	0.2	0.1	....	0.3	0.1	0.2	0.1	0.1
Production (1,000 bbls.)	5,366	5,421	4,762	4,478	4,274	4,252	4,449	5,327	5,957	5,568	5,992	4,814

Source: Adapted from annual estimates of the Rice Millers' Association, New Orleans, Louisiana.

Edith, and Japan, form only a very small part of the Louisiana crop. Varieties grown in other producing states are the same as in Louisiana, but with a much different distribution. In 1938 and 1939, only 31 per cent of the Texas crop was Blue Rose, with Rexoro holding a position of equal importance. In Arkansas, Early Prolific is unusually important and



Source: *Agricultural Statistics*, United States Department of Agriculture.

FIGURE 3. COMPARISON OF ROUGH RICE YIELDS IN THE RICE PRODUCING STATES, 1909 TO 1941.

accounts for 37 per cent of the crop. California specializes in short-grain rices and the principal portion of its crop is Japan, a variety of little importance in the southern states.

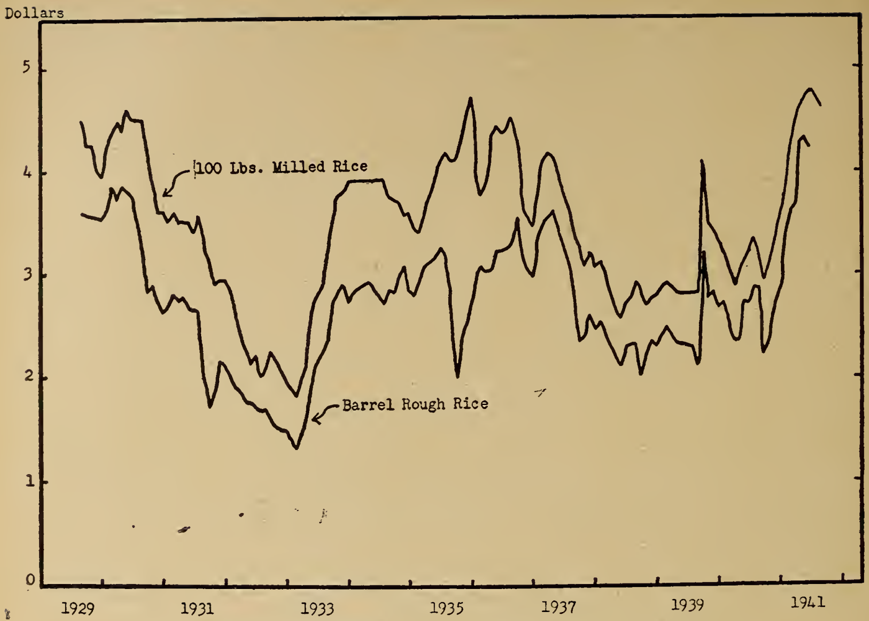
This increased production of all rice and increased importance of long-grain quality rices in the United States has resulted in an increasingly difficult problem in rice marketing. Domestic demand for rice is inelastic—that is, the quantity consumed per capita in the United States remains relatively constant regardless of price fluctuations. Consequently, increased supplies must be sold in the insular territories or in foreign markets, where a profitable price is unlikely if there is competition from Asiatic rice. Because of the present war and shipping shortage, export markets for United States rice exist without competition from Asiatic rice and the problem of a rice "surplus" has been temporarily eliminated. In some future peace-time world, however, the growing United States production will certainly face an export problem of dimensions heretofore not contemplated. It is imperative that suitable production and marketing adjustment for the rice industry be considered before peace occurs and the industry is bankrupted by a sudden change in demand and supply conditions.

PRICE TRENDS FOR ROUGH RICE

There is no central market or generally accepted trade quotation on the price of rough rice, since each sale is an individual bargain between the producer and processor. The most representative price series available is the monthly state estimate computed by the Agricultural Marketing Service, which has the disadvantage of being an estimate based on all grades and varieties of rough rice. Milled rice quotations are available from brokers handling rice in the New Orleans and New York markets, although again there is no uniform trading price except a general range at which wholesale sales are being made.

Rough and Milled Rice

The price a farmer receives for rough rice is a direct reflection of milled rice prices in the wholesale market. Rice milling in Louisiana and Texas is highly competitive, and the price paid by a miller for rough rice is determined by the price he receives for milled rice less processing costs. Any unusual spread that appears between milled and rough rice prices offers an immediate opportunity for mills with excess capacity to profit by bidding higher on rough rice. Temporarily, of course, spreads may increase when mills are holding large inventory stocks of rough rice bought at lower prices, or may decrease when mills are bidding up rough rice in expectation of higher milled rice prices in the near future. Figure 4 indicates that price spreads are greatest on a declining market or when prices are high, since rice buying and milling on such a market involves relatively greater risk. Spreads grow smaller on an advancing or low market, when the risk involved in holding rice stocks is reduced.



Source: *Agricultural Statistics*, United States Department of Agriculture.

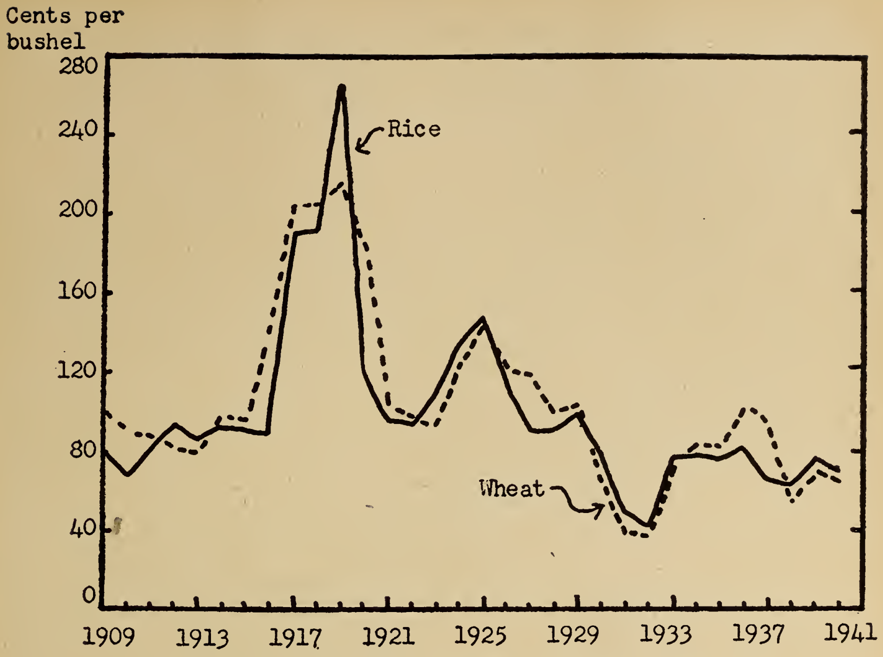
FIGURE 4. WHOLESALE PRICE OF MILLED FANCY BLUE ROSE RICE AT NEW ORLEANS AND PRICE RECEIVED FOR ROUGH RICE BY LOUISIANA FARMERS, 1929 TO 1941.

The relationship between prices can be emphasized by a comparison of rough and milled rice prices converted to cents per pound. Since 1931 the average monthly spread between the price of milled Fancy Blue Rose at New Orleans and the average farm price of rough rice in Louisiana has varied from one cent in 1932 to 3.1 cents under the processing tax of 1935, and to 2.1 cents in recent years. There is a strong tendency for the monthly spread to fluctuate around 1.5 cents a pound when the milled rice wholesale price is 3 cents a pound, narrowing whenever milled rice is lower than 3 cents and increasing when milled rice rises above this level.

Farmers thus receive a price per pound of rough rice averaging about 50 per cent of the wholesale price of fancy milled rice per pound. Roughly, about 62 per cent of the weight of rough rice is converted to milled rice, with the remaining 38 per cent going into by-products, hulls, and invisible loss. On this basis, farmers receive about 2.42 cents of the value of wholesale milled rice sold at 3 cents per pound, or 81 per cent of the wholesale price. The remainder, .58 cents per pound of milled rice plus the value of by-products, accrues to the mills as a processing and selling margin.

Long-Run Price Factors

Aside from current fluctuations in price resulting from incomplete knowledge of demand and supply conditions, there are three broad factors which determine the general trend of rice prices. Probably most



Source: *Agricultural Statistics*, United States Department of Agriculture.

FIGURE 5. Comparison of Prices Received by Farmers for Rice and Wheat in the United States, 1909 to 1941.

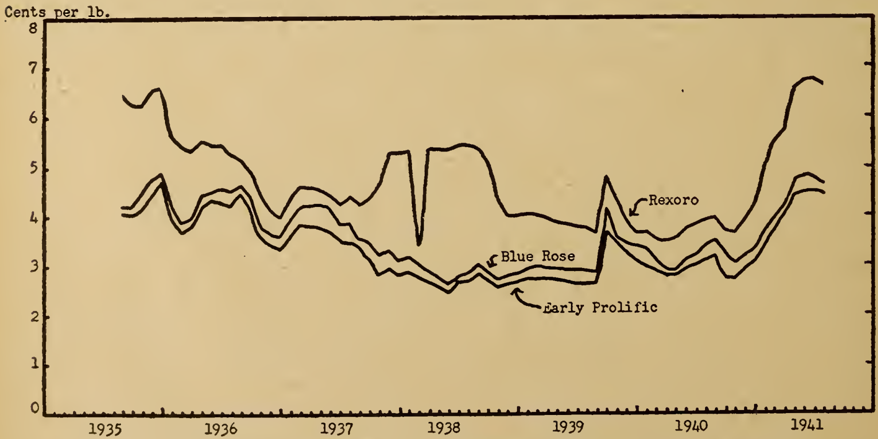
important over a period of five or more years is the movement in the general level of all prices in the United States—in other words, pronounced fluctuations in the purchasing power of money are responsible for the major long-run price movements. Second in importance in the long run, although of primary importance during a short period, is the supply of rice. Demand is inelastic in the United States, and price must drop very low in order to encourage a relatively small increase in domestic consumption. Finally, a major factor at any time is the supply of American rice that must be sold in an export market in competition with Asiatic rice. In normal times, United States rice must be priced very low to sell in foreign markets since Asiatic rice, if available, sells at a low price in the same markets. However, the export market may be a price-raising factor if Asiatic rice is not available to foreign consumers who insist on rice supplies because of long-established dietary habits.

These three factors are the principal influences explaining any marked trends or changes in price over a period of a year or more, and should govern policies of individuals or of government agencies when long-range programs affecting acreage or production are considered. The purchasing power of money alone is a dominant influence. The chart comparing rice and wheat prices indicates clearly that major fluctuations in rice prices are closely associated with major fluctuations for other important farm product prices. To a farmer engaged in the rice business, however, long-run or generalized factors are not of immediate concern in marketing problems, since daily price problems are largely a matter of seasonal price fluctuations and price differentials between varieties and grades.

Prices by Varieties

At times the wholesale price range between the different varieties of rice grown in the southern states may be more than one dollar per 100 pounds of extra fancy milled rice. Blue Rose and Early Prolific prices are the basis of the price structure and define the general price trend, with Early Prolific generally about 20 to 30 cents under Blue Rose in the wholesale market. The prices of long-grain rices such as Rexoro do not bear a constant relationship to Blue Rose prices, since they appeal to limited quality markets or to foreign markets with somewhat rigidly inelastic demand. When rice prices are low or declining, the long-grain quality rices may be sold at substantially higher levels, as in the 1937-1939 period. Rough rice prices tend to reflect these milled rice differentials between varieties, although the milling outturns are often lower for long-grain rice, and consequently the relationship is not directly proportional.

The selection of varieties by any farmer is a matter of harvest requirements and yield adaptabilities on his farm as well as of price considerations when selling rice. In general, however, it appears that a farmer can obtain maximum total profits by growing high-quality long-grain rice such as Rexoro and Nira when rice prices are low, while when prices are high, he will do well to devote his acreage to the production of the highest-yielding varieties adapted to his farm. Another factor which must be considered is market preference, which changes when certain markets decrease or increase in importance. For example, the recent increased importance of the Cuban market should encourage farmers to grow more Rexoro, the rice preferred in that market.



Source: Annual Market Summaries of Southern Rice, Agricultural Marketing Service.

FIGURE 6. Average Price per Pound of Extra Fancy Milled Rice at New Orleans, by Varieties, 1935 to 1941.

TABLE 3. AVERAGE PRICE PER POUND OF EXTRA FANCY MILLED RICE AT NEW ORLEANS, BY VARIETIES, 1935 TO 1941.

YEAR AND VARIETY	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Annual average
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
1935-36:													
Blue Rose	4.21	4.22	4.50	4.78	4.90	4.18	3.87	3.98	4.44	4.55	4.57	4.52	4.39
Early Prolific	4.09	4.04	4.14	4.45	4.71	3.98	3.70	3.80†	4.23†	4.36†	4.32†	4.25	4.17
Fortuna	6.00	5.64	5.59	5.91	5.88	4.76	4.49	4.45	4.63	4.63	4.58	4.50	5.09
Rexoro	6.45	6.26	6.26	6.56	6.62	5.62	5.41	5.32	5.52	5.46	5.45	5.27	5.85
AVERAGE[1]	5.19	5.04	5.12	5.45	5.53	4.64	4.37	4.39	4.70	4.75	4.73	4.64	4.88
1936-37:													
Blue Rose	4.65	4.41	3.77	3.63	3.61	3.97	4.22	4.26	4.26	4.16	3.85	3.86	4.05
Early Prolific	4.48	4.18	3.60	3.43	3.34	3.62	3.86	3.83	3.78†	3.70†	3.49†	3.50	3.73
Fortuna	4.56	4.54	4.03	3.80	3.72	4.06	4.41	4.40	4.38	4.22	3.99	3.94	4.17
Rexoro	5.17	4.93	4.41	4.11	3.99	4.36	4.61	4.60	4.55	4.44	4.22	4.40	4.48
Nira	4.72	4.82	4.48	4.16	4.25	4.61	4.86	4.78	4.72	4.60	4.20	4.31	4.54
AVERAGE[1]	4.72	4.58	4.06	3.83	3.78	4.12	4.39	4.37	4.34	4.22	3.95	4.00	4.19
1937-38:													
Blue Rose	3.56	3.49	3.21	3.32	3.12	3.19	3.05	2.87	2.76	2.66	2.82	2.87	3.08
Early Prolific	3.40	3.14	2.84	2.97	2.85	2.90	2.79	2.70	2.60	2.48	2.70	2.71	2.84
Fortuna	3.96	3.89	4.06	4.88	4.95	4.92	4.90	4.90	4.92	4.92	4.92	4.92	4.68
Rexoro	4.24	4.38	4.65	5.26	5.30	5.32	5.41	5.38	5.37	5.36	5.42	5.45	5.13
Nira	4.35	4.35	4.68	5.20	5.26	5.34	5.40	5.35	5.37	5.34	5.38	5.44	5.12
AVERAGE[1]	3.90	3.85	3.89	4.33	4.30	4.33	4.31	4.24	4.20	4.15	4.25	4.28	4.17
1938-39:													
Blue Rose	3.05	2.90	2.73	2.82	2.85	2.96	3.00	2.94	2.92	2.95	2.92	2.90	2.91
Early Prolific	2.85	2.72	2.58	2.66	2.69	2.76	2.77	2.78	2.73	2.70	2.66	2.66	2.71
Fortuna	4.80	4.56	3.87	3.64	3.65	3.80	3.79	3.69	3.59	3.50	3.46	3.44	3.82
Rexoro	5.38	5.09	4.36	4.01	4.02	4.05	4.05	3.99	3.88	3.85	3.79	3.78	4.19
Nira	5.38	4.89	4.33	4.00	4.02	4.05	4.05	4.00	3.88	3.85	3.79	3.78	4.17
AVERAGE[1]	4.29	4.03	3.57	3.43	3.45	3.52	3.53	3.48	3.40	3.37	3.32	3.31	3.56
1939-40:													
Blue Rose	2.86	4.19	3.58	3.45	3.38	3.36	3.10	2.93	2.93	3.16	3.23	3.45	3.30
Early Prolific	2.67	3.73	3.48	3.30	3.12	3.02	2.92	2.82	2.81	2.94	3.02	3.14	3.08
Fortuna	3.24	4.35	4.16	3.79	3.61	3.58	3.45	3.36	3.41	3.51	3.54	3.57	3.63
Rexoro	3.66	4.83	4.32	3.91	3.65	3.69	3.52	3.51	3.56	3.77	3.83	3.94	3.85
Nira	3.66	4.83	4.34	3.94	3.69	3.70	3.59	3.56	3.58	3.72	3.76	3.88	3.85
AVERAGE[1]	3.22	4.39	3.98	3.68	3.49	3.47	3.32	3.24	3.26	3.42	3.48	3.60	3.54
1940-41: *													
Blue Rose	3.52	3.20	3.04	3.22	3.32	3.71	3.97	4.22	4.74	4.81	4.78	4.62	3.93
Early Prolific	3.21	2.75	2.72	2.94	3.08	3.44	3.80	4.01	4.47	4.50	4.52	4.42	3.66
Rexoro	3.97	3.71	3.67	3.91	4.22	5.02	5.55	5.72	6.58	6.76	6.76	6.66	5.21
Nira	3.91	3.68	3.68	3.97	4.24	5.06	5.55	5.72	6.58	6.76	6.76	6.66	5.21
AVERAGE[1]	3.65	3.34	3.28	3.51	3.72	4.31	4.72	4.92	5.59	5.71	5.70	5.59	4.50

[1] Simple average of monthly prices. †Nominal. *Because of reduced production, Fortuna was not reported in this year.

Source: Annual Market Summaries of Southern Rice, Agricultural Marketing Service.

Prices by Grades

Price differentials between grades of rough rice are difficult to analyze because of the absence of sufficient representative data. Except for a brief and unsatisfactory experience with compulsory grading in 1934, rough rice grades have never come into general use in the marketing structure. The only objective data on premiums and discounts for rice quality are furnished by the American Rice Growers' Cooperative Association, which has followed a practice of obtaining grade certificates on lots of rice sold for its members. When sales are made, the grades and prices are circulated among members in the cooperative's weekly market report.

Analysis of American Rice Growers' Cooperative Association price data during most months and years is difficult because of constant fluctuations in the market, with insufficient sales at any given price level to permit adequate analysis. In selected periods of stable market situations since 1930, however, analysis indicated that premiums and discounts for varying qualities of rough rice usually range up to 10 per cent either way from the average price paid for rice. During 1938, for example, high prices were uniformly associated with high grades of rice (Table 4). Although most rice sells within a 50-cent price range, pronounced quality differentials were accompanied by corresponding extremes in premiums and discounts.

Similar conclusions are indicated by tabulations of data when Blue Rose rice was sold in large quantities on a stable market during a one-month period (Table 5). Rice bringing the lowest prices had the lowest average milling yield estimates, lowest quality, and lowest grading character-

TABLE 4. RELATION OF GRADING FACTORS TO PRICES FOR LOTS OF RICE SOLD BY THE AMERICAN RICE GROWERS' COOPERATIVE ASSOCIATION, 1938.

PRICE	No. sales in group	Av. No. bags in lot	Average U. S. grade	AVERAGE PERCENTAGES OF				Average Estimated Milling Yield	
				Moisture	Red rice	Total damaged kernels	Chalky kernels	Head	Total
	No.	*No.*	*Grade*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Lbs.*	*Lbs.*
Early Prolific:									
$1.51 - 1.75	18	1,427	1.5	13.5	1.7	16.9	6.1	84	108
1.76 - 2.00	82	1,113	1.4	13.4	1.6	18.7	4.5	86	109
2.01 - 2.25	118	1,287	1.2	13.0	0.6	10.3	5.4	88	110
2.26 - 2.50	3	1,258	1.3	13.3	2.0	14.0	4.9	91	110
AVERAGE	221	1,234	1.3	13.2	1.1	14.0	5.2	87	110
Blue Rose:									
$2.01 - 2.25	52	821	1.7	13.2	3.4	22.6	5.1	93	112
2.26 - 2.50	185	1,274	1.4	12.9	2.3	14.9	5.1	94	113
2.51 - 2.75	17	1,957	1.4	13.3	1.7	14.2	5.0	95	114
2.76 - 3.00	3	2,243	1.0	13.5	1.0	8.3	2.4	99	114
AVERAGE	257	1,278	1.4	13.0	2.5	16.3	5.2	94	113

Source: Weekly market releases of the American Rice Growers' Cooperative Association.

TABLE 5. RELATION OF GRADING FACTORS TO PRICES RECEIVED FOR BLUE ROSE RICE SOLD BY AMERICAN RICE GROWERS' COOPERATIVE ASSOCIATION IN FEBRUARY, 1935.

PRICE	No. sales in group	Average U. S. grade	AVERAGE PERCENTAGE OF			Average Estimated Milling Yield	
			Red rice	Moisture	Total damaged kernels	Head	Total
	Number	*Grade*	*Per cent*	*Per cent*	*Per cent*	*Lbs.*	*Lbs.*
$2.51 - 2.55	2	3.5	5.3	12.2	31.5	86	108
2.56 - 2.60	2	3.5	2.0	13.6	69.5	88	110
2.61 - 2.65	2	5.0	1.3	12.6	14.5	85	109
2.66 - 2.70	7	2.7	4.0	14.1	46.7	88	111
2.71 - 2.75	6	3.8	5.6	12.9	28.2	90	112
2.76 - 2.80	5	2.8	1.2	13.8	31.2	90	111
2.81 - 2.85	12	3.1	3.5	13.5	34.6	90	111
2.86 - 2.90	17	2.8	1.8	13.2	34.2	90	111
2.91 - 2.95	9	2.4	9.1	13.5	37.1	90	111
2.96 - 3.00	15	1.7	4.4	13.7	24.3	92	111
3.01 - 3.05	32	2.1	5.8	13.5	29.3	92	112
3.06 - 3.10	34	1.9	7.2	13.4	22.6	92	112
3.11 - 3.15	41	1.6	6.5	13.3	19.3	93	112
3.16 - 3.20	30	1.7	5.3	13.6	20.8	94	112
3.21 - 3.25	28	1.6	5.0	13.3	16.8	96	113
3.26 - 3.30	37	1.3	2.5	13.3	15.7	96	113
3.31 - 3.35	33	1.2	2.1	13.1	14.6	96	113
3.36 - 3.40	12	1.2	1.2	13.1	16.1	98	114
3.41 - 3.45	12	1.0	1.2	13.4	15.4	97	114
3.46 - 3.50	4	1.2	2.8	13.4	12.8	99	114
AVERAGE OF ALL	340	1.8	8.3	13.4	22.5	94	112

Source: Weekly market releases of the American Rice Growers' Cooperative Association.

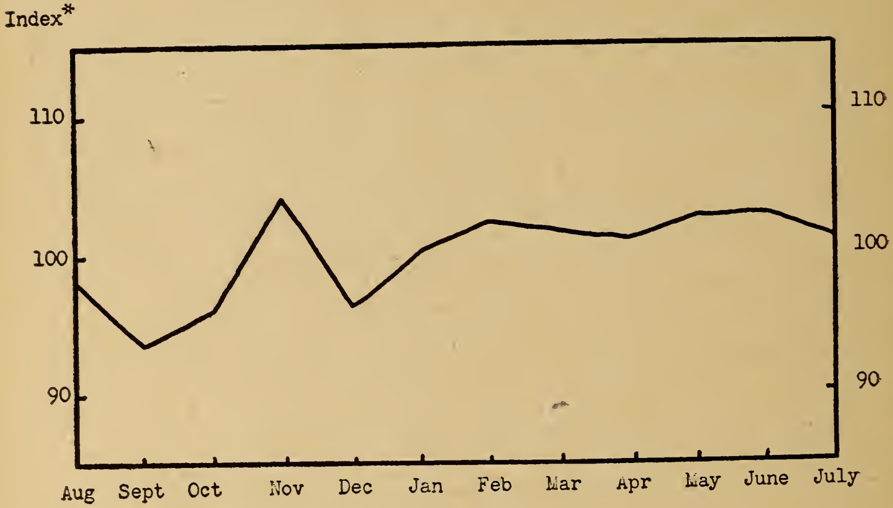
istics for moisture, red rice, and damaged kernels. Evidently the mills pay the farmers premiums for better rice, and a farmer producing poor or damaged rice is penalized as much as 10 per cent when selling his rice. It is likely that farmers in general tend to receive such premiums and discounts for rice, although they may not be as marked as the cooperative data indicate, since most Louisiana rice is sold without a grade certificate and consequently quality differentials may be more frequently disregarded.

Seasonal Variation

The average seasonal variation of Louisiana rice prices at the farm for the years between 1930 and 1939 is shown on the accompanying chart (Figure 7). During these years, prices have generally been lowest immediately preceding the new crop movement in September, and have usually been highest in November when the mills are most active in buying. Price normally declines in December because the mills have filled their storage space and exhausted their cash resources, while the market is also less active because of the holiday season. After a price recovery in January, prices do not show any significant pattern of movement during the remainder of the season, for movement is then dependent more on long-run factors than on seasonal influences.

The usual pattern of seasonal price movement is subject to drastic shifts when changes in demand and in the general price level overcome the influence of forces rising from supply and from mill buying policy. Figure 8 shows the pattern of price movements for each crop year between 1921 and 1939, expressed as a percentage of the October price. In no single year did the pattern of seasonal movement conform directly to the average seasonal index previously illustrated, since changes in demand or in the general price level almost invariably had a significant influence. Nevertheless, there is still a strong tendency for prices to rise in November, with the average advances being greater than the occasional declines.

In 13 of the 19 years shown, a farmer would have received in November as high or higher prices as if he had sold in October, but in 11 years prices would have been lower in December than in October. During the past 20 years a farmer who stored rice each year would have sold at a higher average price than a farmer selling each year in October. General conclusions from these data are that October and December are the weakest price periods during the active marketing year, and that November is usually a favorable month in which to sell. As a general rule, prices are as favorable in November as can be expected at any time during the year. Active buying in this month, after supplies are known and mills must meet their selling and storage requirements, forces prices up in order to induce farmers to sell immediately and forego speculation.



*Monthly average for the year equals 100.

FIGURE 7. Index of Average Seasonal Variation for Rough Rice Prices in Louisiana, 1930-1939.

Favorable years for rice storage past November are those when the general price level is rising, or when a change in demand is forcing a

TABLE 6. Prices Received by Louisiana Farmers for Rice Expressed as a Percentage of October Price, 1920-41.

Year	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
1920–21.......	100.0	100.0	78.1	63.3	61.7	64.0	59.4	65.5	61.0	58.6	75.0	76.6
1921–22.......	100.0	90.7	90.7	114.4	99.9	111.3	93.8	89.7	102.1	111.3	108.2	83.5
1922–23.......	100.0	128.6	115.5	115.5	110.7	129.8	130.9	104.8	128.6	144.0	122.6	128.6
1923–24.......	100.0	96.4	95.5	99.1	100.0	97.3	100.9	117.1	121.6	123.4	118.9	116.2
1924–25.......	100.0	102.3	110.2	112.5	110.2	108.5	107.8	110.9	116.4	117.2	114.1	111.7
1925–26.......	100.0	105.5	106.2	106.9	104.2	99.3	90.9	95.1	97.9	101.4	80.6	81.9
1926–27.......	100.0	99.1	98.2	99.1	96.4	97.3	93.7	92.9	91.1	92.9	80.4	81.2
1927–28.......	100.0	96.8	97.9	98.9	94.7	95.7	97.8	102.1	104.3	98.9	97.8	97.8
1928–29.......	100.0	103.3	104.4	107.7	105.5	105.5	106.6	102.2	103.3	103.3	109.9	108.8
1929–30.......	100.0	101.0	100.0	102.0	109.2	105.1	109.2	108.2	106.1	101.0	89.8	80.6
1930–31.......	100.0	98.7	94.8	97.4	101.3	98.7	100.0	96.1	96.1	94.8	72.7	61.0
1931–32.......	100.0	127.7	125.5	119.1	112.8	110.6	104.2	104.2	102.1	97.9	100.0	100.0
1932–33.......	100.0	97.6	97.6	90.5	85.7	95.2	111.9	133.3	142.8	145.2	154.7	178.6
1933–34.......	100.0	102.6	96.2	99.9	101.3	102.5	103.4	99.9	98.7	96.2	101.3	99.9
1934–35.......	100.0	102.4	93.9	92.7	98.8	102.4	103.6	104.8	108.4	106.0	89.2	66.3
1935–36.......	100.0	107.7	113.8	127.7	130.8	127.7	129.2	136.9	136.9	138.5	139.9	152.3
1936–37.......	100.0	96.6	94.3	105.7	111.5	112.6	114.9	109.2	102.3	97.7	87.4	74.7
1937–38.......	100.0	103.8	85.0	90.0	82.5	78.8	71.2	72.5	78.8	80.0	80.0	75.0
1938–39.......	100.0	106.2	100.0	101.5	106.2	100.0	98.5	98.5	98.5	96.9	89.2	136.9
1939–40.......	100.0	102.6	97.4	98.7	90.8	85.5	85.5	98.7	98.7	103.9	103.9	78.9
1940–41.......	100.0	123.1	123.1	147.7	163.1	161.5	192.3	192.3	186.2	180.0	163.1	133.8
1941-42.......	100.0	133.3	155.2	......	......	......	......	......	......	......	......	......

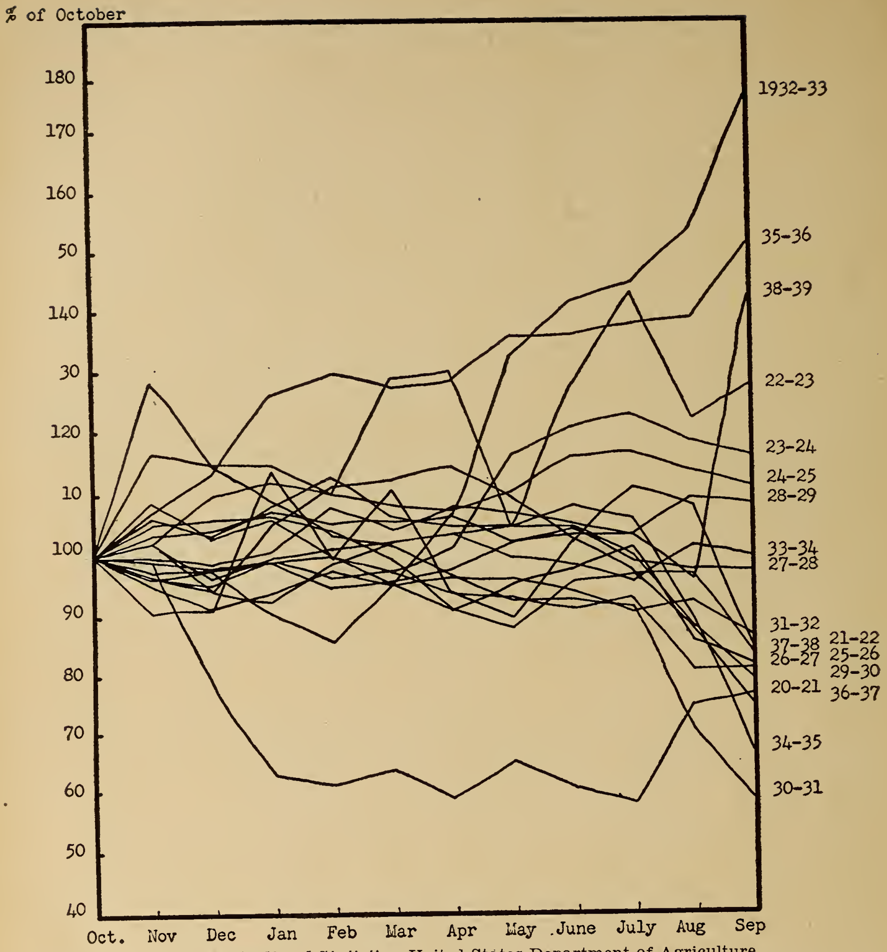
Source: *Agricultural Statistics*, United States Department of Agriculture.

rise in prices. Unfavorable years for further storage are those when the general price level is declining, or when foreign demand prospects are poor. Since it is difficult to forecast these forces, prolonged storage of rice is normally a speculative operation.

It is an interesting fact that both November and January, months when prices are relatively high, are also months of relatively high rough rice sales. In December, when prices are weak, sales are relatively low. This indicates the great importance of the buying policies of the mills. After a period of large rough rice sales, prices are likely to decline since the mills are not interested in buying until they liquidate some of their current holdings and restore their financial and physical capacity to increase their rough rice purchases.

STORAGE FACILITIES FOR RICE

About half of the rice crop in the states of Louisiana, Texas and Arkansas is sold by farmers during the months of harvest, August through November. The balance of the crop is stored until a later date, usually in large public rice warehouses located at milling centers and towns within the rice producing areas. In addition, rice sold directly from the field frequently is handled through warehouses for assembly, weighing, and grading. Public storage facilities are therefore important institutions in rough rice marketing, and have a significant influence on marketing problems confronting rice farmers in Louisiana.



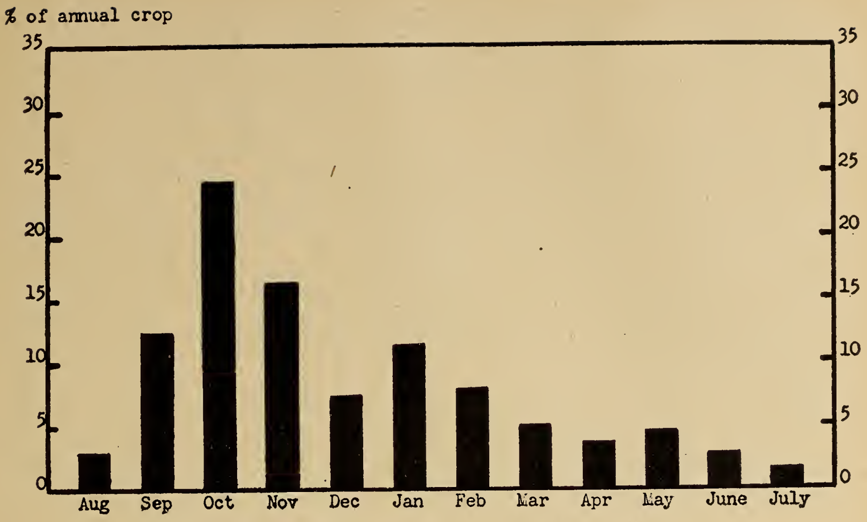
Source: *Agricultural Statistics*, United States Department of Agriculture.

FIGURE 8. Price Received by Louisiana Farmers for Rough Rice Expressed as a Percentage of October Price, 1920 to 1939.

As illustrated in Figure 9, southern mills received an average of 56 per cent of their annual rough rice supplies between August and November in the years from 1935 through 1938, when crop movement was not unduly disturbed by unusual incidents. The peak movement was in October, with an average of 24.4 per cent of annual receipts.

Number and Capacity of Rice Warehouses

Most of the public warehouses storing rice for Louisiana farmers are under state bond, except for a few federal bonded warehouses operated by milling interests. According to a survey made by the Louisiana Agricultural Experiment Station, there were 100 state and federal bonded rice warehouses within the southwest Louisiana rice area during the crop



Source: *Agricultural Statistics,* United States Department of Agriculture.

FIGURE 9. AVERAGE MONTHLY DISTRIBUTION OF ROUGH RICE RECEIPTS AT MILLS IN LOUISIANA, TEXAS, ARKANSAS, AND TENNESSEE, 1935 THROUGH 1938.

year 1940-41.[2] Of these 100 warehouses, 27 (including all federal bonded warehouses) were operated in connection with rice mills or were under the direct control of rice milling interests, leaving 73 state bonded warehouses that made a business of storing farmers' rice.

The capacities of public rice warehouses ranged all the way from 6,000 bags to more than 100,000 bags, with 57 warehouses having between 20,000 and 60,000 bags.[3] The largest warehouses with capacities of more than 60,000 bags were generally operated by mills or irrigation companies. Independent public storage available to farmers averaged near 30,000 bags per warehouse.

Total bonded rice warehouse capacity in southwestern Louisiana in 1940-41, including both mill and farmer storage, was approximately $4\frac{1}{2}$ million bags, as compared to an annual Louisiana rice crop approaching six million bags of rough rice. Since an appreciable quantity of early variety rice is milled before the late varieties are harvested and stored, rice storage capacity in Louisiana is therefore ample to move the rice crop, although the condition of many warehouses is so poor as to warrant their replacement with new facilities.

Control of Warehouses

Of the total bonded warehouse capacity, about 50 per cent was controlled by independent warehouse operators, about 40 per cent by rice mills, and the remaining 10 per cent by irrigation companies. A large portion of the rice mill capacity is utilized in the early part of the season in storing rice owned by farmers. When the farmer sells his rice, the mills waive accumulated storage and insurance charges on the rice.

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[2] The number of warehouses given here does not agree with the number of bonds listed with the state and federal warehouse authorities or with actual number of buildings storing rice, since some bonded warehouses were inactive and others had added new warehouse space.

[3] Large bags each containing slightly more than four 45-pound bushels of rice.

Operators of the rice warehouses which are independent of rice mills and irrigation companies seldom confine their business strictly to warehousing. About 50 per cent of the independent storage was operated by rice farmers or by local store operators, who through land ownership or credit advances, controlled the rice which entered storage at their warehouses. As a result, only about 20 per cent of the total public rough rice storage space available in the southwest Louisiana rice area can be considered as completely independent of large enterprises engaged in other phases of the rice industry.

Because of these conditions, any consideration of rice storage costs and charges in Louisiana must reckon not with the situation as one controlled by the costs of furnishing storage facilities, but with the interrelated structure of the enterprises controlling storage facilities, and the purposes and nature of such control.

Location of Warehouses

Crowley, the chief milling center, is the principal rough rice storage point in Louisiana, with about 825,000 bags capacity, or almost a fifth of the bonded warehouse capacity of the rice area in 1940-41. Most of this capacity is furnished by rice mills, with slightly less than 200,000 bags available at warehouses independent of mills, irrigation companies, or banks. Kaplan is second in storage capacity, with space for 520,000 bags, of which about two-thirds is furnished by mills.

Other storage points, in order of their importance, are Gueydan, Lake Charles, Eunice, Rayne, Welsh, Jennings, Abbeville, Elton, Iota, and Mermentau. Each of these centers had warehouse capacity for more than 100,000 bags of rough rice in 1940-41.

Storage capacity independent of rice mills or irrigation companies was greatest at Eunice, followed by Crowley, Welsh, Kaplan, and Elton. Bidding for rough rice stocks is most active at these points, since the mills must deal with each farmer and lack the control over bidding they have in their own or associated warehouses.

Charges for Rice Storage

Rates charged farmers for rough rice storage varied greatly in 1940-41, and facilities available at similar rates also varied considerably. This situation was the result of several factors: (1) the influence of custom in maintaining rates generally accepted in the community, (2) forcing down of rates by new warehouse operators attempting to attract business, (3) the practice of warehouse operators in making credit advances so that credit, not storage charges, determines the selection of storage facilities, and (4) the effect of mill policy in waiving storage charges for rice in mill-controlled warehouses. In addition, miscellaneous services such as assembling rice sold at threshing, turning and restacking to dry rice, and quantity discounts accounted for price variability. Usually insurance was carried separately by the growers, but 28 out of 79 warehouses included insurance in their storage charges.

TABLE 7. RATES CHARGED FOR STORAGE IN 79 PUBLIC BONDED RICE WAREHOUSES IN SOUTHWEST LOUISIANA, 1940-41, PER LARGE BAG.

NUMBER WAREHOUSES	RATES CHARGED BY MONTHS					Rate for Season
	First	Second	Third	Fourth	Fifth	
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Without insurance (51)						
14	10	..	..	..	..	10
12	7	5	3	..	..	15
10	8	4	3	..	..	15
3	6	4	2	..	..	12
2	8	5	3	..	..	16
2	8	4	..	..	..	12
2	7	5	3	2	..	17
1	10	3	2	..	..	15
1	8	2	2	..	..	12
1	10	2	2	1	..	15
1	8	2	..	..	..	10
1	14	..	..	..	..	14
1	8	..	..	..	..	8
With insurance (28)						
8	7	5	3	..	..	15
3	8	5	3	2	2	20
2	8	6	3	2	1	20
2	10½	3½	2½	..	..	16½
2	8	6	4	2	..	20
1	8	6	4	2	2	22
1	8	4	3	2	1	18
1	8	5	3	..	..	16
1	8	4	2	..	..	14
1	15	..	..	..	..	15
1	7	4	3	..	..	14
1	6	4	2	..	..	12
1	5	4	3	..	..	12
1	6	6	..	..	..	12
1	10	..	..	..	..	10
1	5	5	..	..	..	10

The most common charge made by bonded warehouses in Louisiana during 1940-41 was 7 cents per bag the first month, 5 cents the second, and 3 cents the third month or fraction thereof, with 15 cents a bag being the maximum charge for the season. Twenty out of 79 warehouses studied made this charge, eight of them including insurance in this storage fee. Next in general use was a flat rate of 10 cents, without insurance, although this rate was confined largely to a number of warehouses in one locality.

Both flat rates ranging between 8 and 14 cents for season storage and progressive monthly combinations reaching up to 22 cents and extending over periods up to five months were found in the rice belt. The highest rate charged by any public warehouse in the producing area was 8-6-4-2-2 cents including insurance, which adds up to a seasonal total of 22 cents a bag for storage of five months or longer. The lowest rate in the area with insurance was 5-5 cents, or a total of 10 cents for the season. Without insurance, the highest rate charged a grower was 7-5-3-2 cents, or a total of 17 cents for the season. The lowest rate without insurance was a flat 8 cents, but this was established because of an unusual fire hazard and consequent high insurance costs.

During 1940-41, the lowest charges for public rice storage in the rice belt were established at Crowley, with a prevailing rate of 5-4-3 cents, including insurance, accumulating to a 12 cent maximum charge for the season. Competition among warehouse operators for storage at Crowley was very bitter, since there were large independent warehouses as well as extensive mill facilities available to farmers. Highest rates were charged in Vermilion Parish, with the town of Gueydan being the most expensive rice storage point in southwest Louisiana. However, the existence of high rates did not mean that most farmers paid high charges in this latter area. Practically all of the rice space at Gueydan and throughout Vermilion Parish was controlled by mills and irrigation companies and storage payments were seldom made by farmers.

TABLE 8. USUAL STORAGE RATES AT MOST IMPORTANT RICE STORAGE CENTERS IN SOUTHWEST LOUISIANA, 1940-41.

PARISH AND TOWN	Number warehouses* operating	MOST COMMON STORAGE RATES	
		By Months	For Season
	Number	*Cents*	*Cents*
St. Landry:			
Eunice	6	10	10
Acadia:			
Crowley	10	5–4–3†	12†
Rayne	7	7–5–3†	15†
Iota	4	10	10
Mermentau	3	8–4–3	15
Vermilion:			
Abbeville	5	8–6–4–2†	20†
Kaplan	6	8–5–3–2–2†	20†
Gueydan	4	8–6–3–2–2–1†	22†
Jefferson Davis:			
Jennings	4	7–5–3–2	17
Welsh	3	7–5–3	15
Elton	4	8–4	12
Country points	..	7–5–3	15
Calcasieu:			
Lake Charles	5	7–5–3	15
Vinton	2	10–2–2–1	15
Other points	..	8–4–3	15
Allen:			
Kinder	1	7–5–3	15

*Includes mill warehouses. †With insurance.

A rate generally satisfactory to both farmers and warehouse operators appeared to be the charge of 7-5-3 cents, without insurance, prevailing throughout Jefferson Davis Parish. In Calcasieu Parish, rates of 8-4-3 cents amounted to the same season charge. In these areas a considerable volume of warehouse capacity is free of mill control, and charges are adjusted to maintain independent operation.

From this analysis, it appears that farmers in Louisiana pay reasonable storage charges on rough rice. Any complete estimate of operation, maintenance, and capital costs for moderate-sized rice warehouses with about 30,000 bags capacity indicates that a minimum revenue of at least 10 cents a bag on full capacity is necessary to meet expenses. Much Louisiana rice moves through warehouses on a one-month charge below 10 cents, while total season charges do not greatly exceed this figure.

Rice warehouse operators in Louisiana offer a minimum of services in handling the rice crop and in aiding farmers to sell their rice. If more services were offered, charges would probably have to be raised. Since Louisiana farmers do not demand much marketing service from warehousemen, and since mill storage is attractive to farmers wishing to avoid storage charges, independent rice operators do not find warehousing a very thriving business except in isolated localities or when associated with other activities in milling, merchandising, irrigation, or financing.

Storage on Farms

County agents estimate that less than 5 per cent of all rice farmers own facilities for storing rice on their farms, although the requirements are simple and the necessary investment is small. In recent years, however, there has been a tendency toward construction of storage facilities on the larger rice farms. A survey of 38 farmers utilizing farm warehouses in 1940-41 revealed that their average total acreage available for rice approached 600 acres, and that an average of 288 acres of rice was planted in the preceding year. Apparently a large rice acreage is necessary to justify the trouble and expense of a farm building suitable for rice storage. The 38 farm warehouses averaged 3,360 bags in capacity, ranging from 1,575 bags on the smallest farms to 5,100 bags on the largest farms.

Of 40 separate structures, 21 were built of wood frame with galvanized iron roofing, 18 were frame with galvanized iron sides, and only one was a structure constructed entirely from lumber. Six of the structures were converted barns and four were buildings constructed many years ago. For 30 rice warehouses constructed in recent years, the average cost to the farmer was $827. The cost varied with capacity, ranging from $223 for four small warehouses to $1,340 for five warehouses with capacities of over 5,000 bags. Usually the farmer furnished most of the labor himself, so that construction costs involved principally the purchase of materials.

Costs of maintenance are very low, and a farmer who saves 10 cents a bag when storing 3,000 or more bags of rice soon pays for the materials and receives a substantial return for his labor in constructing the building. Although there is cost for hiring labor to stack rice in the farm warehouse, the farmers estimated that the saving in cost for hauling to public storage equaled this cost for additional harvest labor. The farmers were unanimous in their opinion that their farm warehouses were profitable investments, even at the high construction prices and low public storage rates of 1940-41.

Rice in farm warehouses is usually sold f. o. b. farm, since good roads in the area make farm warehouses as accessible as storage facilities in town. Although storage on farms thus appears to have few disadvantages, it is unlikely that the practice will have more than limited expansion in the future. Three principal factors operate as retarding influences. Small farms producing less than 1,000 bags are most numerous in the Louisiana rice area, and the amount of saving is not highly attractive when combined with possible difficulties in marketing small lots at the farm. Further, credit arrangements with farmers draw much rice into public warehouses, either through credit advances from the warehouse operator or through the need for negotiable warehouse receipts. Finally, the present low charges at public warehouses and the mill practice of waiving storage charges will cause most farmers to persist in traditional storage practices.

PROBLEMS IN RICE MILLING

One of the most striking characteristics of rough rice marketing is the scarcity of middlemen. Rice moves from the farmer direct to the mills, and from the processor through brokers to wholesale or export markets. Direct marketing has frequently been advocated as a desirable procedure in selling agricultural products, but problems caused by this mechanism are unusually evident in the rice trade. Although the presence of middlemen in a market spreads the farmer and consumer farther apart, ordinarily this spread results in distribution of speculative risks. In rough rice marketing, the absence of middlemen means that rice growers must carry all speculative risks not assumed by the mills. Since rice milling concerns ordinarily are better acquainted with market conditions, farmers must usually assume speculative risks when these risks are most dangerous, since there are no other speculative operators in the market to relieve the presure.

In recent years retail outlets have tended more and more to maintain their stocks of rice on a narrow basis, relying on the mills to make replacements quickly available. This increases still further the speculative risks on the mills and on the farmers. When the wholesale market is inactive, farmers may be unable to find any market for rough rice, since mills are reluctant to buy on any basis when market trends look unfavorable.

Estimating Rough Rice Value

With this speculative element affecting each sale of rough rice and without official market price quotations or objective grade standards, rough rice marketing is largely a "higgling" transaction between the farmer and salaried or commission buyers representing the rice mills. In purchasing rough rice, the common practice among all buyers is to draw a representative sample from the bags in each lot. A lot of rough rice may include all of a farmer's rice of one variety, or, if there are distinct differences in the quality of rice between different fields, the rice from one farm may be divided into several lots.

A portion of the sample is "rubbed" or "shelled" in order to remove the hulls. This operation is carried out more or less thoroughly depending on the attitude of the buyer and the difficulty in evaluating the rice. The rice is usually rubbed with a block on a rough board or stone, the object being to apply sufficient pressure and friction to judge the effect of milling machinery. The rubbing process removes the hulls and part of the bran, and the proportion of whole and broken kernels in the sample provides an estimate of the yield of whole (head) rice and total yield of rice products (whole and broken kernels) in a barrel of rough rice. For example, after rubbing a sample of Blue Rose, a buyer may estimate that 94 pounds of head rice and 110 pounds of total rice products will be secured from 162 pounds of rough rice. This estimate of yield is the most important factor influencing the value of a lot of rough rice.

Other factors estimated by the buyer are the moisture content and the general appearance of the rice, with particular attention to red rice, weed seeds, and damaged kernels. A portion of the rice is weighed in a small cup to determine the weight per bushel. Other factors being equal, the total yield of milled rice products will be greatest for heavy rice, since there will be a lower weight in hulls and trash after milling.

This system of selling rice has been established by traditional practice in the rice industry. Although many improvements have been advocated in the past two decades, and some changes have been achieved, there is still room for the adoption of devices to improve the handling of rough rice between the farmer and the mill or to improve the bargaining power of farmers. Some marketing improvements are hindered by technological difficulties—for example, bulk handling of rice in Louisiana requires the development of adequate rice drying methods. A market news service was established in 1928 but more effective distribution of current situations to farmers is a problem still to be solved. Rough rice grades were developed by the federal government in 1927, but have found no general use in the industry. Centralized selling, a device which would eliminate the expense of individual negotiation between each farmer and the mills, has been advocated but adopted in Louisiana only by those farmers who sell through the American Rice Growers' Cooperative Association.

Nature of Rice Milling

The prime object in milling rice is to remove the hull and bran while preserving as many as possible of the kernels as whole grains. Brown rice, containing the germ and layers of bran, is distributed on a limited scale, but has no general demand nor is its keeping quality very good, as it becomes rancid. The usual product entering trade channels is milled rice, graded as to color, quality, and percentage of broken kernels, with a high polish and frequently a coating of glucose and talc imparted to the better grades of whole head rice. Broken rice is separated into three classes. The largest broken particles are termed second head rice; the next largest particles are screenings; and the smallest particles are brewers' rice.

Milled Rice Outturn

Although mills differ somewhat in the amount of each of the various products obtained from rough rice, in general about 68 per cent of the weight of rough rice is recovered in whole and broken rice, about 30 per cent as by-products including hulls, bran, and polish, and the remaining 2 per cent disappears in debris and invisible waste. Although milled rice products are only 68 per cent of the rough rice weight, it is estimated that whole and broken rice accounts for 94 per cent of the total value of rice products. Head rice alone generally contributes about 83 per cent of the total value of rice products. By-products, making up 30 per cent of the weight of rough rice, yield only about 6 per cent of the total value.

TABLE 9. ESTIMATED PROPORTION OF VARIOUS PRODUCTS OUT-TURNED FROM ROUGH RICE IN THE MILLING PROCESS, BY WEIGHT AND VALUE.

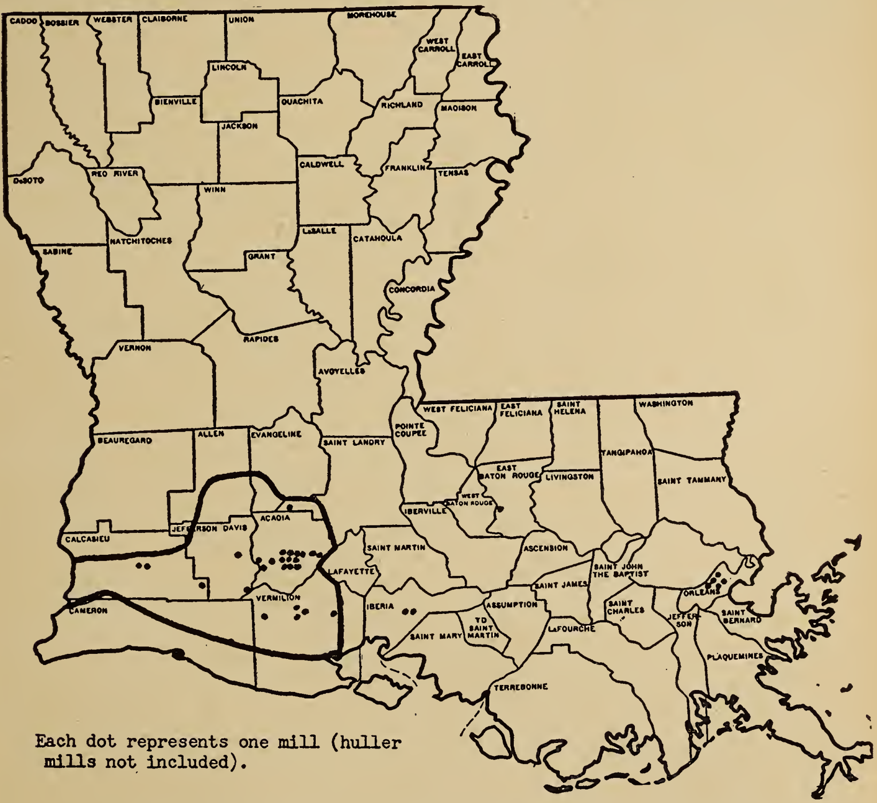
RICE PRODUCTS	Percentage of total weight	Percentage of market value
	Per cent	*Per cent*
Milled rice:		
Head	57.0	82.8
Second head	3.5	4.0
Screenings	6.0	5.9
Brewers	2.0	1.8
TOTAL MILLED RICE	68.5	94.5
By-products:		
Polish	2.0	0.8
Bran	8.5	2.6
Hulls	20.0	2.1
TOTAL BY-PRODUCTS	30.5	5.5
Waste (trash, debris)	1.0	0.0
TOTAL	100.0	100.0

Source: From data furnished by the Rice Millers' Association.

Development of Milling Industry

The first rice mills in Louisiana were built in New Orleans during and shortly after the War Between the States, when the river area was becoming an important center of rice production. Until the decade of 1900-1910, New Orleans was the principal rice milling center of the nation. By 1900, rice production was booming in the southwest prairie section of Louisiana and numerous mills were constructed in the new area. By 1910 there were 35 or 40 mills in southwest Louisiana, most of them poorly financed and managed by promoters inexperienced in the rice business. Many went into bankruptcy soon after construction, causing considerable loss to farmers who had subscribed to stock.

During the 1940-41 season, 34 fully equipped rice mills operated in Louisiana. In addition, three large huller mills doing business on a broad scale were in operation. Five mills which were fully equipped for operation were idle, either shut down temporarily for repairs or because of financial difficulties. Small huller mills also operated in most of the towns scattered through the rice area, but their operations were not significant except in hulling rice for local use.



Each dot represents one mill (huller mills not included).

FIGURE 10. Location of Rice Mills Operating in Louisiana During 1940-41 Milling Season.

Capacity of Milling Centers

As shown in figure 10, 26 of the 34 mills active in 1940-41 were located within the southwest Louisiana rice producing area. Two mills were operating at New Iberia in the Teche rice area, one at Baton Rouge and five at New Orleans.

Crowley is the principal rice milling center in Louisiana and in the

United States. Ten mills were operating there in 1940-41, with another large mill temporarily idle. The total capacity of the ten active mills, measured in barrels of rough rice per hour, was 900 barrels, or 28.5 per cent of the total estimated active capacity of 3,160 barrels per hour in Louisiana. New Orleans is the second most important Louisiana milling center, with five mills and a capacity in 1940-41 of approximately 550 barrels per hour, or 17.4 per cent of the total capacity. Together these two cities had 45.9 per cent of the milling capacity in 1940-41.

The most important of the other milling points in 1940-41 were Kaplan, 340 barrels per hour; Lake Charles, 320 barrels; and Rayne, 250 barrels. Five cities thus accounted for 75 per cent of the milling capacity of the state, with the remaining 25 per cent scattered among ten different milling points.

TABLE 10. NUMBER OF ACTIVE MILLS AND THEIR ROUGH RICE CAPACITY, BY MILLING POINTS, IN LOUISIANA, 1940-41, 34 MILLS.*

MILLING POINT	Number of mills	Total barrels per hour	Percentage of total capacity
	Number	*Barrels*	*Per cent*
Crowley	10	900	28.5
New Orleans	5	550	17.4
Kaplan	3	340	10.8
Lake Charles	2	320	10.1
Rayne	2	250	7.9
Abbeville	1	150	4.7
Jennings	1	125	4.0
Mermentau	2	120	3.8
Gueydan	1	90	2.9
New Iberia	2	85	2.7
Baton Rouge	1	80	2.5
Lake Arthur	1	50	1.6
Eunice	1	40	1.3
Estherwood	1	30	0.9
Hayes	1	30	0.9
ALL MILLS	34	3,160	100.0

*Excludes three large huller mills processing and distributing rice in interstate trade. Three important mills did not operate during 1940-41, and one new mill was constructed during the summer of 1941.

The total 1940-41 capacity of 3,160 barrels per hour in the large mills, which excludes idle mills and all huller mills, demonstrates the large excess capacity existing in the Louisiana rice milling industry. The 34 mills, operating only 8 hours a day, could mill a 5-million-barrel Louisiana rice crop in 198 days, or about seven months. Since the mills ordinarily work longer hours or double shifts during the harvest season and whenever the rice market is active, their effective capacity greatly reduces this period during which all mills can operate on the Louisiana rice crop. If all Louisiana mills operated 24 hours a day, and mills temporarily idle were utilized, a Louisiana rice crop could be milled in less than

100 days.[4] Excess capacity in the industry is permanently maintained by the fact that entry into small-scale rice milling involves little capital investment. Any attempt to diminish competition among the large rice mills is followed by the entry of numerous small operators into the business.

This condition of excess capacity is highly important in its effect on the economics of rough rice marketing. Most mills attempt to mill as large a volume as possible in order to reduce overhead costs to a minimum, and consequently competition between mills is very bitter both in buying rough rice and in selling milled rice. This struggle for utilization of excess capacity tends to maintain a competitive market for rough rice. It also leads to frequent disputes with rail carriers in which each Louisiana rice mill seeks to secure a rough and milled rice rate structure which will enable it to utilize its capacity more effectively.

Size of Mills

About a third of the mills operating in Louisiana in 1940-41 had capacities in excess of 100 barrels of rough rice per hour. About half of the total number could mill between 20 and 60 barrels per hour. Small mills are thus most numerous, and units built in recent years indicate a trend toward smaller operating units in the industry. In spite of this trend, however, large mills are still the dominating influence in the industry. The four largest mills had 27 per cent of the hourly 1940-41 capacity operating in the state, and the 11 largest mills had 57 per cent of the total. One large milling company, operating five large mills in Louisiana, controlled over 26 per cent of the milling capacity active in 1940-41.

TABLE 11. MILLING CAPACITIES OF 34 MILLS OPERATING IN LOUISIANA DURING 1940-41.

CAPACITY IN BARRELS PER HOUR	Number of mills	Total capacity	Percentage of total capacity
	Number	*Barrels*	*Per cent*
20 - 40	9	310	9.8
41 - 60	6	325	10.3
61 - 80	2	150	4.7
81 - 100	6	560	17.7
101 - 120	0	...	....
121 - 140	4	505	16.0
141 - 160	3	450	14.2
161 - 180	0	...	....
181 - 200	2	400	12.7
201 - over	2	460	14.6
ALL MILLS	34	3,160	100.0

In purchasing Louisiana rice, local mills do not face serious competition from out-of-state mills. The freight rate structure tends to keep Arkansas and Texas mills in their own localities. Data compiled by the Agricultural Marketing Service indicate that Louisiana mills, including huller mills, process about 91 per cent of the Louisiana crop, with about 2 per cent going to Texas and Memphis mills, and the remaining 7 per cent used for feed, seed, and carryover on Louisiana farms. Each interior Louisiana rice mill buys most of its rice within the immediate vicinity of the mill, although large mills may buy throughout the belt when they wish immediate supplies.

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[4] This excess capacity is not peculiar to Louisiana, but is found also in Texas and Arkansas. Hall and Douglas, in Arkansas Bulletin No. 355, *Storage and Transportation of Arkansas Rice,* estimate that Arkansas mills could process the Arkansas crop in less than 100 24-hour days.

Milling Costs

Most fully equipped mills estimate that their average cost for milling rice is approximately 60 cents plus the value of by-products. Examination of confidential cost data indicates that about 41 per cent of the total milling costs per barrel are costs varying directly with the amount of rice processed, while 59 per cent are overhead and selling costs for the maintenance of the mill and its buying and selling services. Direct costs are principally labor and sacks, while brokerage and salaries account for most of the overhead and selling costs. Altogether, direct costs for labor and sacks and indirect costs for brokerage, salaries, and interest account for about 44 cents of the usually estimated 60 cents in total estimated milling costs per barrel of rough rice. Mill supplies, fuel, taxes, office expense, telephone and telegraph, insurance, and profit must come out of the remaining 16 cents plus the value of by-products.

Speculation in Inventories

Thus, with heavy overhead and selling costs, with excess capacity, with easy entry into the industry, and with a narrow milling margin, a rice miller is forced to look to shrewd buying and selling for his major milling profits. Indeed, it may be said that profit in rice milling is based more on purchasing and selling efficiency than on milling efficiency. The speculative risk is great, since a relatively small decline in rice prices quickly wipes out any profit margin on rice inventories held by a mill, with the converse true for increases in prices. When there is a rising trend in the market, most mills build up as large an inventory as possible, being limited only by storage and financial capacity. On a declining market, the mills operate on a hand-to-mouth basis and will buy ahead only at a substantial discount under current milled rice-rough rice price relationships. Consequently, the rough rice market goes through periods of extreme activity and extreme dullness.

Rice mills occasionally sell rice "short," that is, they make sales of milled rice for future delivery before they have purchased rough rice to cover the sale. This speculative practice is avoided by conservative operators, but is nevertheless an important factor in mill operation. Naturally, short sales are most prevalent when the rough rice market is declining. Although there is nothing inherently damaging to farmers when a mill is "short" as compared to "long," i.e., when large inventories of rough rice are carried at the mill; farmers generally feel that millers use "short" sales intentionally to force prices down. Since "short" sales are usually associated with a declining market, and since rumors of "short" sales are a depressing influence on an indeterminate market, such operations have earned a bad reputation in the rice trade.

When commodities are sold on organized future exchanges, the processors are able to escape inventory speculation by hedging their purchases of rough rice and sales of milled rice. Shortly after World War I, the Rice Millers' Association made efforts to establish organized spot and future trading in both rough and milled rice at New Orleans. On November 5, 1923, the New Orleans Rice Clearing Association opened a rice futures market under the auspices of the Louisiana Sugar and Rice Exchange. This market had for its avowed objectives the stabilization of the rice industry, the provision of hedges for both growers and millers, the provision of a market for purchase of future rough and milled rice requirements, and the attraction of speculators to carry the marketing risks.

For several years, an effort was made to maintain daily quotations on rough and milled rice, both spot and in twelve future months. Gradually, since these quotations would remain nominal for days and even weeks at a time, interest in support of the market lagged. Trading, never large, dropped to practically nothing within several years of its inception. The lack of objective grades, direct nature of trading between farmers and millers, extreme quality variability in deliveries on future contracts, and uncertain market liquidity effectively prevented hedging operations. By 1927 all futures trading had ceased, with the general cause of its failure ascribed by a prominent official to the fact that the rice industry was too narrow to maintain a successful futures board.

Influence of Freight Rate Structures

Since efficiency in purchasing rough rice and in selling milled rice is thus the dominant influence on success in rice milling, the location of a mill in regard to freight rate charges is of vital importance. Although milled rice is ordinarily sold in Louisiana f.o.b. mill, a guaranteed freight rate is frequently quoted in order to give the buyer a definite delivered price. The principal difficulties with rate structures are experienced by mills outside the producing area, particularly in New Orleans, since here the proportionate relationship between rough and milled rice rates determines competitive efficiency in buying and selling as compared to mills within the producing area. Each mill seeks a rate structure that will permit it to buy rough rice in as wide an area as possible while at the same time retaining such rates which will keep other mills out of both its local source of supply and its milled rice markets.

In general, present rate structures are such that long hauls of rough rice to mills outside the producing area are discouraged. In addition, the use of trucks in hauling rough rice to interior mills gives the latter a moderate buying advantage. Although small mills located in the producing areas thus have a buying advantage, they have a disadvantage in maintaining extensive selling connections. This explains the organization characteristics of several large milling concerns which sell milled rice from a single office controlling the sales of several plants scattered through the rice areas.

COOPERATIVE MARKETING

The most permanent, and perhaps most effective, market improvements so far achieved in the rice industry have resulted from cooperative marketing associations among rice farmers. The rice industry is localized, with relatively large production units and progressive farmers, and has therefor afforded an unusual opportunity for the development of cooperative marketing.

Cooperative marketing facilities now available to Louisiana farmers are furnished by the American Rice Growers' Cooperative Association, which operates in both Texas and Louisiana.[5] This association was established in 1928 as a reorganization of the American Rice Growers' Association, which had operated in the southern rice area since 1921. Other cooperative associations that have been active in the Louisiana rice area include the Southern Rice Growers' Association from 1911 to 1920, and two Farm Bureau associations during the 1920-1930 decade. The present association has been more successful than any preceding organizations in Louisiana.

TABLE 12. Total Barrels of Rough Rice Handled by the American Rice Growers' Cooperative Association, 1928-1941.

Year	Total No. districts	Total barrels sold	Louisiana		Texas		Arkansas	
			No. districts	Barrels sold	No. districts	Barrels sold	No. districts	Barrels sold
	Number	*Barrels*	*Number*	*Barrels*	*Number*	*Barrels*	*Number*	*Barrels*
1928–29	6	1,172,362	3	363,700	3	808,662	0	......
1929–30	12	1,471,826	7	503,688	5	968,138	0	......
1930–31	14	2,081,616	7	706,313	6	1,336,233	1	39,070
1931–32	13	2,070,678	6	528,277	6	1,520,912	1	21,489
1932–33	15	2,010,518*	8	431,777	6	1,315,701	1	13,040
1933–34	13	1,930,671*	7	529,640	6	1,009,018	0	......
1934–35	12	2,075,206	6	840,825	5	1,185,219	1	49,162
1935–36	13	2,091,014	6	655,359	5	1,406,386	1	29,269
1936–37	13	2,335,765	6	737,651	6	1,578,669	1	19,445
1937–38	14	2,565,197†	6	644,639	7	1,523,383	1	160,175
1938–39	14	2,730,046	6	631,252	7	2,017,356	1	81,438
1939–40	15	2,588,542	6	578,793	9	2,009,749	0	......
1940–41	15	2,719,437	6	540,301	9	2,179,136	0	......

*Includes estimates of unreported sales not included in state totals.
†Includes 237,000 barrels unsold on June 1, 1938, not included in state totals.
Source: Files of American Rice Growers' Cooperative Association, Lake Charles, Louisiana.

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[5] Operations in Arkansas have been discontinued, since the Arkansas Rice Growers' Cooperative Association offers cooperative services in that area.

Organization Characteristics

The American Rice Growers' Cooperative Association is organized as a loosely federated group of local cooperative marketing agencies, with a central office providing those market services which are more efficiently performed on a large scale. Local districts are self-controlled cooperative units with a local board of directors elected by the grower-members, and each district maintains a sales office, manager, and samplers. Each local district is represented on a central association board of directors, with directors allocated on the basis of one to each 100,000 barrels handled, or fraction thereof. This central board of directors conducts the affairs of the central association, which from a main office in Lake Charles, Louisiana, coordinates the activities of the district associations, supervises operations for unincorporated districts, and maintains a market news service and a grading office servicing all the districts. Except for matters of general policy, the local districts are autonomous units and the central association does not exert rigid control over their activities.

Number of District Cooperatives

The number of local districts operating under the American Rice Growers' Cooperative Association has varied between 6 and 15 during the 13 years between 1928 and 1941. In the initial marketing season of 1928-29, two districts operated in Texas and four in Louisiana. In later years, additional districts were organized in both of these states, and one in Arkansas. The Arkansas district discontinued operation after the 1938-39 season, since sufficient volume outside of the Arkansas Rice Growers' Association was not available. In Texas and Louisiana, new districts were established in new rice areas or large districts were broken up into smaller districts, with occasional cessation of operations in small districts or merger of several small neighboring districts. In general, the officers of the cooperative regard 75,000 to 100,000 barrels as the minimum volume necessary to support a local district.

During the 1940-41 marketing season, 9 of the 15 district associations were located in Texas and 6 in Louisiana. Although Louisiana produces much more rice than Texas, the principal strength of the cooperative association has always been in Texas. In the first years of operation, about a third of the total cooperative sales were made in Louisiana and about two-thirds in Texas, but in recent years Louisiana has furnished only a fifth of the total volume. Slightly more than 10 per cent of Louisiana rice is now marketed through district associations, while more than half of the Texas crop is marketed by this means.

Somewhat less than 500 rice growers were formally affiliated with Louisiana district associations during 1940-41.[6] According to estimates of the district managers, the Welsh district was the largest with about 110 growers, and Elton and Iowa served 72 and 40 growers, respectively. The Holmwood and Kaplan districts are selling agencies maintained by large

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[6] In the 1940 Census of Agriculture, the number of rice farms reported in Louisiana was 5,835.

TABLE 13. BARRELS OF RICE HANDLED BY LOCAL DISTRICTS OF AMERICAN RICE GROWERS' COOPERATIVE ASSOCIATION, 1928-1941.

DISTRICT	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
	Barrels	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*
LOUISIANA:													
Holmwood	...	...	108,386	79,841	68,169	82,294	89,082	63,799	70,511	61,230	59,114	66,770	58,329
Iowa	41,131	81,255	76,822	61,937	33,447	64,542	60,609	45,819	68,806	54,948	50,335	63,508	68,431
Welsh	138,058	211,815	234,040	166,515	45,774	141,183	286,454	195,835	199,974	171,325	159,667	117,160	147,740
Elton	...	28,978	108,451	99,494	56,399	79,603	108,907	73,407	73,141	76,031	53,360	48,910	63,551
Crowley	...	...	77,355	62,930	153,849	79,221	109,809	88,241	109,474	89,858	104,028	80,215	61,297
Kaplan	...	...	...	...	...	76,489	185,964	188,258	215,745	191,247	204,748	202,230	140,953
Sulphur	20,819	18,912	12,352	...	...	...	...	...	...	...	...	...	...
Lake Charles	163,692	127,728	88,907	57,560	6,416	6,308	...	...	...	...	...	...	...
Kinder	...	11,475	...	...	...	...	...	...	...	...	...	...	...
Vinton	...	23,525	...	...	...	...	...	...	...	...	...	...	...
Rayne	...	...	...	...	58,032	...	...	...	...	...	...	...	...
Eunice	...	...	...	...	9,691	...	...	...	...	...	...	...	...
TEXAS:													
Orange	...	...	...	...	...	...	...	...	...	56,342	57,194	62,046	64,249
Beaumont	315,688	293,422	347,640	349,227	382,532	217,196	377,722	351,794	371,924	234,001	458,281	274,273	384,756
Anahuac	...	...	...	...	...	...	...	...	...	...	...	65,224	138,325
Devers	...	191,164	263,642	218,886	225,822	168,278	188,597	200,485	236,236	243,105	344,883	324,547	309,221
Houston	492,974	332,141	420,027	486,268	475,057	330,886	318,642	396,516	409,119	439,083	564,108	439,219	364,997
Katy	...	...	...	...	...	...	...	...	...	...	...	275,313	288,495
Eagle Lake	...	...	...	248,049	173,636	216,611	235,216	226,912	237,664	278,741	280,450	297,895	304,704
Garwood	...	73,308	84,490	70,223	58,654	76,047	65,042	93,002	69,899	128,206	117,071	142,124	191,610
Rosharon	...	...	...	...	...	...	...	137,677	253,827	143,905	195,369	129,108	132,779
El Campo	...	78,103	182,237	148,259	...	...	...	...	...	...	...	...	...
Pierce	...	...	38,197	...	...	...	...	...	...	...	...	...	...
ARKANSAS:													
Stuttgart	...	...	39,070	21,489	13,040	...	49,162	29,269	19,445	160,175	81,438	...	...
ALL DISTRICTS:													
Unreported or unsold	...	...	...	...	250,000	392,013	...	...	...	237,000	...	...	...
TOTAL SALES	1,172,362	1,471,826	2,081,616	2,070,678	2,010,518	1,930,671	2,075,206	2,091,014	2,335,765	2,565,197	2,730,046	2,588,542	2,719,437

Source: Files of American Rice Growers' Cooperative Association, Lake Charles, Louisiana.

irrigation and land companies which pay the central association fee in order to obtain the market news service and other facilities of the central association. The number of growers formally affiliated with the district associations, however, does not indicate accurately the number of farmers whose rice is handled by cooperative methods. A large landowner may sell the rice of numerous tenant farmers through the association, or rice in which several persons have interests may be sold as a single lot.

Method of Financing

Since the volume of rice handled is more important to the financial success of the association than number of members, efforts to increase the efficiency of operation have centered on increasing the volume of rice in membership contracts rather than the number of members. In general, members of both the Louisiana and Texas district associations are large growers of rice, since careful marketing increases in significance to an individual as his quantity to be sold becomes larger. Although the collective gains of small operators from careful marketing could be large, small operators usually are not disposed to incur the expense and trouble involved in sampling, grading, and centralized marketing in face of the relatively small individual gains on their lots of rice.

The principal source of revenue for both the local districts and the central association is the commission collected on each barrel of rice marketed. The central association collects 2 cents per barrel while the fee collected by the local districts varies from 3 to 8 cents according to the policy of the local association. All Louisiana districts charged 4 cents a barrel during 1940-41, which added to the 2-cent central association fee made a total charge of 6 cents a barrel for cooperative marketing services.

Services to Members

The district associations assemble for grading samples of rice grown by their members, and handle all the details involved in the negotiations for sale and delivery of rough rice. The central association maintains grading offices at Beaumont and Eagle Lake in Texas where the rice is graded according to federal standards by association graders. The central office at Lake Charles is concerned principally with the maintenance of a market news service. Each district sales manager is kept informed on prices for rice sold in other districts, with sales being designated by grade, variety, and purchasing mill. The central association also distributes each week important market reports and rice statistics, with a recapitulation of cooperative sales for the week and notes concerning the affairs of the cooperative association and the rice industry.

Services to Rice Industry

By the above methods the American Rice Growers' Cooperative Association has made available a sales agency which enables the maintenance of competition and thereby enforces a reasonable efficient selling structure for all rice growers, whether members or non-members. Probably just as important, however, has been the service which the cooperative has rendered as an instrument for presenting the growers' point of view in the extensive government legislation affecting agriculture during the past decade. The central association officers were influential in abolishing the ill-advised marketing agreement of 1933 and 1934, in establishing the processing tax program of 1935, in gaining important concessions for rice growers in recent Agricultural Adjustment Act revisions, and in making direct appropriations for and in encouraging industry action in trade negotiations, advertising programs, and rice research. All rice growers have evidently gained by these activities, regardless of their affiliation with the association. Without the cooperative association as an effective and active agent in national affairs the economic situation for all rice growers would undoubtedly have been much less favorable during the past decade.

A POSITIVE PROGRAM

The principal requirements of a suitable marketing structure, from a farmer's point of view, are these: (1) that necessary services be performed as efficiently and cheaply as possible, (2) that the farmers know their product and market situation sufficiently well, and have financial support sufficiently strong, to place them in an adequate bargaining position, and (3) that competition be enforced among the business enterprises through which the product moves to the consumer. Present rough rice marketing practice indicates that these requirements would be better satisfied, respectively, if: (1) bulk handling and centralized selling were used to reduce necessary costs for storage, transportation, handling, and assembling, (2) market news service, rough rice grade knowledge, and independent credit standing were utilized by all farmers to increase their bargaining strength, and (3) competition among millers and buyers were enforced by farm organizations constantly on guard against monopolistic practices wherever they might occur.

Several broad difficulties in the Louisiana rice industry retard the development of improved marketing practices. The highly speculative and competitive nature of the milling industry, leading to cut-throat competition and to unstable attempts at monopolistic practice, has created an atmosphere of suspicion under which each miller and each farmer trusts only his personal attention in bargaining for rice. Furthermore, the interlocking of mills and irrigation companies with rice farmers through credit, storage, or direct participation in making a rice crop makes independent bargaining difficult to establish. Finally, improved marketing practices can secure no more than a fair competitive value for rice, so that the direct comparative value of a better marketing structure can not always be observed, particularly in years when an advancing market puts all farmers in a strong bargaining position. The numerous small rice growers in Louisiana are usually more interested in short-run immediate gains than in the improvement of the long-run economic situation in rice marketing. The good to be accomplished by an improved marketing structure is usually evident only when prices are weak or declining, but the structure must be improved during prosperous periods so that it will have strength to endure when farmers are most in need of help.

Marketing Between Farmers and Millers

If costs incurred in assembling rice at the mills could be reduced, farmers would gain either from their own savings or from the higher prices paid by the millers. Marketing costs intervening between the farm and the mill include those for transportation, storage, insurance, purchasing, and assembling rough rice. To reduce these costs to a minimum, it is essential that competition be maintained among agencies supplying all marketing services, that accurate market news and quality differentials become general knowledge, that farmers and millers act to reduce costly methods of purchasing rice, and that handling costs be reduced by adoption of technical improvements.

To make such improvements, the following steps are essential:

1. Bulk handling and storage of rice should be encouraged where possible. This requires further experimentation in methods of drying and handling rice, perhaps with a different approach from past practices in adapting methods used for other gains.

2. The sale of rice through bids on samples at centrally located sales offices should be encouraged, in order to reduce the cost of expensive buying practices and to promote competitive evaluation of rice.

3. During the months of heavy rice marketing, a state agency should assemble daily reports on rice sales and arrange for a brief current market report through radio stations at Lake Charles and Lafayette.

4. The Extension Service should educate farmers on the principles and uses of rough rice grades, not as a specific grade to price differentials, but to enable them to utilize market information and to promote competition in growing the best quality of product.

5. In general, Louisiana rice farmers should be convinced that improved marketing requires first of all independent control of rice until time of sale and thorough knowledge of both rough and milled rice markets. Improved marketing can not be secured to any major extent by reforming mill practices. Most mill practices result from a struggle for survival in a competitive system, and the maintenance of competition between mills is highly desirable.

6. Independent control of rice requires, first of all, that farmers finance their rice production and storage through agencies not interested in controlling rice for profit from private storage or from milling. The substantial improvements so far made in the credit situation by the Production Credit Associations should be continued and considerably extended.

7. Cooperative storage and marketing are useful in achieving independent control of rice and in promoting competitive buying for both

members and non-members. Policies of the Production Credit Association and the Bank for Cooperatives should be interrelated so that individual farmers, financed in producing the crop by an agency not interested in storing or milling the rice, will find it possible to join in cooperative enterprises in storing and marketing the crop.

Efficiency in Milling and in Milled Rice Distribution

Farmers will also gain if the processing margin between rough rice and milled rice can be reduced. For the rice milling industry as a whole, the available evidence indicates that intense competition keeps milling profits, in the long run, at a reasonable level, so that farmers can not seek greater returns by a reduction of mill profits. Reduction in the milling margin can be achieved only by technological or organizational improvements to secure greater milling efficiency, by reduction of speculative risks in rice milling through market stabilization, by more profitable utilization of by-products, and by promotion of increased demand for rice in both the domestic and foreign markets.

These principles suggest the following policies:

1. So long as excess capacity and bitter competition are prevalent in the Louisiana rice milling industry, farmers should not attempt cooperative milling since greater gains are to be realized by taking advantage of the competitive struggle among mills. Cooperative mills should be regarded only as a tool to enforce competition, along with state and federal legislation against restraint of trade.

2. Practices of mills designed to meet competitive demands, such as the mixing of various grades and varieties of rice, should be eliminated primarily by stimulation of consumer demand for better grades of rice. Some mixing of rice will probably always be essential in meeting price requirements in a competitive industry.

3. The rice industry, assisted by public agencies where needed, should encourage research into more profitable utilization of rice by-products in both human and animal nutrition and in industrial fields. Studies of milled rice distribution and preferences in specific localities in the United States are needed as a basis for development of a program to increase domestic rice consumption.

4. The rice industry should take advantage of the inelastic domestic demand for rice by limiting supplies in the domestic market. This requires federal aid in the establishment of appropriate tax measures, tariff preferences, or favorable quotas, particularly in regard to the Cuban market.

5. Louisiana farm groups should exert pressure in freight rate litigation to insure the maintenance of a rate structure that will permit the maximum number of mills to buy rice throughout the Louisiana growing area and prevent so far as possible the purchase of rough rice in other areas by Louisiana mills.

6. Technological advances in milling will become more significant

if the rice market can be stabilized so that the speculative factor in milling can be reduced in importance. In the meantime, all mills as a group, aided by public agencies, should sponsor experiments to secure greater technical efficiency in the milling of rice.

Efficiency in commodity marketing is difficult to secure, since in many cases efficiency is difficult to define. Practices which appear unduly expensive are often based on physical peculiarities of the commodity or on psychological reactions of the individuals concerned. Inefficient marketing can endure only if efficient competitors are eliminated by monopolistic enterprises or by the prejudices of producers or consumers. Consequently, recommendations for the improvement of marketing seldom meet with unanimous approval, and are often resented by those whose vested interests or intangible values will suffer if the recommendations

TABLE 14. ACREAGE, YIELD, PRODUCTION AND FARM VALUE OF ROUGH RICE IN THE UNITED STATES, 1909 TO DATE.

YEAR	Acreage	Yield	Production	Farm value
	1,000 acres	*Bushels*	*1,000 bushels*	*1,000 dollars*
1909	662	35.6	23,586	18,758
1910	666	37.1	24,731	16,785
1911	636	35.6	22,662	18,257
1912	643	36.9	23,700	22,159
1913	722	33.5	24,210	20,824
1914	646	36.3	23,478	21,702
1915	740	35.5	26,107	23,656
1916	843	46.9	39,544	35,162
1917	953	36.4	34,714	85,804
1918	1,101	36.3	39,998	76,696
1919	1,083	39.6	42,911	114,210
1920	1,299	39.8	51,648	61,006
1921	990	39.7	39,274	37,239
1922	1,053	39.6	41,663	38,686
1923	874	38.0	33,238	36,615
1924	838	39.0	32,643	43,934
1925	853	38.7	33,036	49,017
1926	1,016	41.4	42,025	47,513
1927	1,027	43.3	44,497	40,413
1928	972	45.1	43,834	39,950
1929	860	46.0	39,534	39,474
1930	966	46.5	44,929	35,214
1931	965	46.2	44,613	21,642
1932	874	47.6	41,619	17,416
1933	798	47.2	37,651	29,248
1934	812	48.1	39,047	30,854
1935	817	48.3	39,452	30,479
1936	981	50.8	49,820	41,567
1937	1,088	49.1	53,372	35,132
1938	1,076	48.8	52,506	33,714
1939	1,040	51.7	53,722	39,095
1940	1,069	50.9	54,433	44,208
1941*	1,245	43.4	54,028	63,997

*Preliminary.

Source: Compiled from data of the Bureau of Agricultural Economics by the Agricultural Adjustment Administration, Southern Division.

are adopted. It is believed, however, that the recommendations here presented, as based on the preceding analysis, are sufficiently justified to warrant general acceptance by persons concerned in rice production and distribution.

TABLE 15. ACREAGE OF ROUGH RICE HARVESTED IN THE UNITED STATES, BY STATES, 1909 TO DATE.

YEAR	N. C.	Mo.	S. C.	Ga.	Fla.	Ark.	La.	Texas	Calif.	U. S.
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1.000 acres*	*1,000 acres*	*1,000 acres*
1909...	1	..	19	6	1	27	370	238	...	662
1910...	..	..	19	6	1	60	360	220	...	666
1911...	..	..	14	4	1	72	350	195	...	636
1912...	..	..	12	3	1	91	315	220	1	643
1913...	..	..	8	2	1	105	350	250	6	722
1914...	..	..	12	5	1	93	320	200	15	640
1915...	..	..	7	4	1	100	335	213	30	740
1916...	..	..	7	4	1	125	435	212	59	843
1917...	..	..	6	4	2	152	485	216	88	953
1918...	..	..	9	5	2	170	565	230	120	1,101
1919...	..	..	7	4	2	160	543	212	155	1,083
1920...	..	..	..	..	..	180	676	261	162	1,299
1921...	..	..	..	..	..	140	549	166	135	990
1922...	..	..	..	..	..	163	555	195	140	1,053
1923...	..	..	..	..	..	143	474	151	106	874
1924...	..	1	..	..	..	166	430	151	90	838
1925...	..	4	..	..	..	176	414	156	103	853
1926...	..	10	..	..	..	196	492	169	149	1,016
1927...	..	3	..	..	..	179	520	165	160	1,027
1928...	..	10	..	..	..	173	495	162	132	972
1929...	..	..	..	..	..	156	465	144	95	860
1930...	..	..	..	..	..	173	491	192	110	966
1931...	..	..	..	..	..	177	458	205	125	965
1932...	..	..	..	..	..	163	415	186	110	874
1933...	..	..	..	..	..	147	395	148	108	798
1934...	..	..	..	..	..	141	415	143	108	812
1935...	..	..	..	..	..	138	412	167	100	817
1936...	..	..	..	..	..	160	479	204	138	981
1937...	..	..	..	..	..	189	517	250	132	1,088
1938...	..	..	..	..	..	189	494	268	125	1,076
1939...	..	..	..	..	..	171	480	269	120	1,040
1940...	..	..	..	..	..	191	469	291	118	1,069
1941*..	..	..	..	..	..	214	538	340	153	1,245

*Preliminary.

Source: Compiled from data of the Bureau of Agricultural Economics by the Agricultural Adjustment Administration, Southern Division.

TABLE 16. PRODUCTION OF ROUGH RICE IN THE UNITED STATES, BY STATES, 1909 TO DATE.

YEAR	N. C.	Mo.	S. C.	Ga.	Fla.	Ark.	La.	Texas	Calif.	U. S.
	1,000 bu.	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*	*1,000 bu.*
1909...	22	....	528	139	20	1,264	12,617	8,996	.....	23,586
1910...	..	....	522	139	21	2,700	13,320	8,030	......	24,731
1911...	..	....	161	80	20	3,168	11,725	7,508	......	22,662
1912...	..	....	276	66	21	3,958	11,182	8,140	57	23,700
1913...	..	....	176	44	20	4,410	11,200	8,000	360	24,210
1914...	..	....	276	112	18	3,952	11,520	6,700	900	23,478
1915...	..	....	147	88	18	4,600	12,898	6,496	1,860	26,107
1916...	..	....	150	80	18	6,312	20,010	9,434	3,540	39,544
1917...	..	....	123	88	38	6,916	16,005	6,264	5,280	34,714
1918...	..	....	166	88	34	7,140	18,080	7,590	6,900	39,998
1919...	..	....	131	58	33	7,600	19,005	6,784	9,300	42,911
1920...	..	....	....	....	....	8,820	25,012	9,554	8,262	51,648
1921...	..	....	....	....	....	7,490	18,501	5,993	7,290	39,274
1922...	..	....	....	....	....	7,824	19,314	6,825	7,700	41,665
1923...	..	....	....	....	....	5,648	15,879	6,040	5,671	33,238
1924...	..	50	....	....	....	7,138	15,050	6,040	4,365	32,643
1925...	..	300	....	....	....	7,568	14,159	6,209	4,800	33,036
1926...	..	610	....	....	....	10,349	16,236	6,844	7,986	42,025
1927...	..	75	....	....	....	7,697	19,812	7,953	8,960	44,497
1928...	..	400	....	....	....	8,287	18,860	8,116	8,171	43,834
1929...	..	....	....	....	....	7,956	18,832	7,027	5,719	39,534
1930...	..	....	....	....	....	8,218	19,149	10,291	7,271	44,929
1931...	..	....	....	....	....	9,735	16,030	10,598	8,250	44,613
1932...	..	....	....	....	....	8,313	16,392	9,114	7,800	41,619
1933...	..	....	....	....	....	7,203	16,195	7,341	8,912	37,651
1934...	..	....	....	....	....	6,655	16,766	7,370	8,256	39,047
1935...	..	....	....	....	....	6,072	17,296	8,684	7,400	39,452
1936...	..	....	....	....	....	8,752	21,076	10,608	9,384	49,820
1937...	..	....	....	....	....	10,584	20,680	13,000	9,108	53,372
1938...	..	....	....	....	....	9,715	20,748	13,668	8,375	52,506
1939...	..	....	....	....	....	8,430	21,120	15,172	9,000	53,722
1940...	..	....	....	....	....	9,588	18,760	16,645	9,440	54,433
1941*..	..	....	....	....	....	11,342	19,906	13,600	9,180	54,028

*Preliminary.

Source: Compiled from data of the Bureau of Agricultural Economics by the Agricultural Adjustment Administration, Southern Division.

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LOUISIANA BULLETIN NO. 341 MARCH 1942

Profitable Permanent Pastures
For
Dairy Cattle

By

D. M. SEATH

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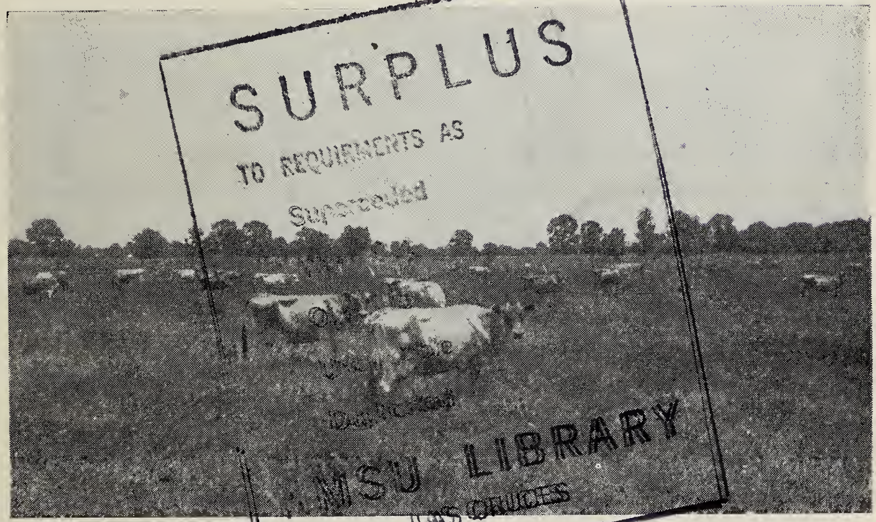

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PROFITABLE PERMANENT PASTURES FOR DAIRY CATTLE

D. M. SEATH*

Milk is in every respect a defense food. Whether a nation is at war or at peace, milk serves as a defense food for both its young and old. It insures a balanced diet, with good teeth, strong bones, clear vision and steady nerves as a result. This state, and the nation as a whole, needs a greater consumption of milk and its by-products in order to effect a needed improvement in human health. To accomplish this there is a need for the production of both more and better milk. One of the most effective methods of attaining this objective is to provide dairy cows with an abundance of green succulent pasture. Such feed causes an increase in milk flow and enriches, in constituents such as minerals and vitamins, the milk produced.

THE EXPERIMENTAL PLAN

This experiment was designed to show what the added returns would be from improved over unimproved permanent pastures on actual Louisiana dairy farms, and was not a test to determine the actual fertilizer treatment necessary for best results on those farms. Accordingly, cooperating farmers were required to keep records on the amount of grazing secured, the pounds of milk produced, and the amount and value of supplemental feed fed cows while grazing the test pastures.

Each test pasture was divided into halves, and each half was treated alike except that one received fertilizer and the other did not. The fertilized half received a complete fertilizer (4-12-4) at the rate of 350 pounds per acre during October or early November of each year. In addition, 50 pounds of nitrate of soda per acre were applied during May of each year. The amount and kind of fertilizer used was not considered the very best for each particular pasture. There was evidence, however, that each test area had soils deficient in both phosphorus and nitrogen, and possibly potash. Also, previous work in the state[1] had shown that best results were secured when all three major plant food elements were applied at the approximate rate used in this test. Two of the three test areas reported on received applications of limestone to correct the soil acidity. Details regarding the amounts used as well as the time applied will be given under the discussion of individual tests.

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* Associate Dairy Husbandman, in charge of dairy research. The author acknowledges work during the early phases of this project by his predecessor, R. H. Lush. He also expresses his appreciation to the cooperating dairymen who furnished pastures and cattle for the tests, and to the Chilean Nitrate Educational Bureau, Inc., for furnishing nitrate fertilizer for the test pastures.

[1] *Results of Pasture Fertilization at Lafayette,* Louisiana Experiment Station Bulletin No. 304, 1939; see also *Biennial Report of North Louisiana Experiment Station, 1937-1938,* page 32.

Test pastures, including those not fertilized, were seeded to clovers and Dallis grass. The clovers included white Dutch, hop and bur. Annual fall seedings of either oats or rye grass were made for two years on one test and for three years on another. Weeds were controlled by two or more mowings each year. Producing Jersey cows grazed each test pasture and were rotated between pasture areas in order to graze the fertilized and unfertilized halves to the same degree of closeness.

The plan used to evaluate the pastures was to credit a test pasture for the milk produced by the cows while grazing that pasture. A uniform selling price of $2.30 per hundred was used for milk testing 5 per cent butterfat, with a 3-cent differential for each 0.1 per cent variation from that test. Fertilizer was valued at $1.75 per hundred pounds. This made a charge of $7.00 against each fertilized acre, since the annual application of fertilizer was 400 pounds per acre. Grain fed as a supplement was charged against the pasture at current feed prices.

FOUR-YEAR AVERAGE RESULTS OF ALL TESTS

A good idea of the benefits obtained from improving permanent pastures can be derived from the four-year average results secured from the three tests located in widely scattered dairy sections of the state. One test was in Claiborne Parish on Norfolk fine sandy loam, another in Lincoln Parish on Ruston very fine sandy loam, and a third in Washington Parish on Cahaba sandy loam. More details in regard to each test will be given later in this bulletin.

TABLE 1. Yearly Grazing Days—All Tests

Year	Number Days Grazed			Cow Days Per Acre*		
	Unfertilized	Fertilized	Per cent Increase	Unfertilized	Fertilized	Per cent Increase
1937..........	56	83	48	101	158	56
1938..........	72	99	38	114	164	44
1939..........	75	123	64	121	212	75
1940..........	79	137	73	171	266	56
Average..	70	110	57	127	200	58

*Days grazed × average number cows ÷ number acres = cow days per acre.

More Days Grazing Secured

As shown in Table 1, the fertilized pastures furnished more days of grazing for each of the four years than did the unfertilized pastures. The difference ranged from an increase of 38 per cent to 73 per cent, with an average of 57 per cent. Both the fertilized and the unfertilized pastures showed an increase in productivity during the four-year period. For 1940, the unfertilized pastures were grazed 79 days, equivalent to 2.6 months, and the fertilized pastures an equivalent of 137 days, or 4.6 months. In neither case was the pasture grazed continuously for such a period, since rotational grazing was practiced.

A better idea of relative grazing capacity of pastures can be obtained in terms of "cow days per acre," as shown to the right in Table 1. The amount of grazing in these units is secured by multiplying the days grazed by the number of cows and dividing the result by the number of acres in the pasture. The final answer is in terms of how many days each acre would supply pasturage for an individual cow. Again the fertilized pasture maintained a distinct lead for each of the four years, ranging from an increase over unfertilized pastures of 44 per cent to 75 per cent and averaging 58 per cent. Fertilized pastures averaged 200 days per cow per acre, equivalent to 6.7 months, as contrasted to 127 days, or 4.2 months, for unfertilized pastures. This showed that fertilization added an average of 73 cow days per acre, or 2.4 months, to that secured without fertilization.

Increase in Milk and Returns Over Feed

In terms of milk per acre, the results (see Table 2) are in line with those secured on the basis of cow days. On an average the fertilized pastures yielded 3,851 pounds of milk per acre, an increase of 1,509 pounds, or 64 per cent, over the unfertilized pastures. This was in line with the 58 per cent increase in cow days of grazing, as shown in Table 1, and indicates that the fertilization of the pastures did more toward increasing the period of grazing than it did in increasing the milk production of cows grazing fertilized pastures, although there was some evidence that the latter took place to a very slight degree.

TABLE 2. Yearly Milk Per Acre and Returns Over Cost of Grain and Fertilizer

Year	Lb. Milk Yearly Per Acre			Returns Per Acre Less Value of Grain Fed and Fertilizer Used*			
	Unfertilized	Fertilized	Per cent Increase	Unfertilized	Fertilized	Increase	
						Amount	Per cent
1937	1,827	3,138	72	$21.18	$30.15	$ 8.97	42
1938	2,225	3,195	44	36.87	46.71	9.84	27
1939	2,092	3,722	78	35.44	52.69	17.25	49
1940	3,226	5,350	66	53.43	81.56	28.13	53
Average	2,342	3,851	64	36.73	52.78	16.05	44

*Grain was valued at prevailing prices, milk at $2.30 per cwt. with a three cent differential for each 0.1% variation from a 5% fat test, and fertilizer at $1.75 per cwt.

After subtracting the value of grain fed as a supplement, annual returns from the milk averaged $23.05 per acre more from the fertilized than from the unfertilized pastures. This difference reduced to $16.05 per acre after deducting the fertilizer cost, $7.00 per acre, from the fertilized pastures (see Table 2), and is indicative of the possibility of increased returns from dairy pastures in Louisiana. It is of particular interest to note that the returns from both groups of pastures increased from year to year over the four-year period, indicating beneficial effects from frequent mowing to control weeds, reseeding, and controlled grazing. Fertilized pastures improved at a faster rate than did unfertilized pastures, showing a 42 per cent advantage in 1937 and increasing to a 53 per cent greater return over feed and fertilizer costs for 1940.

Hay Yields Increase on Fertilized Areas

During late May and October of each of the four years, hay was harvested from protected areas of the test pastures (see Figure 1). This was done to secure a check on grazing results and to determine the effect fertilization had on the mineral content of the herbage. As shown in Table 3, the fertilizer applied to the test pastures increased the yield of air-dry hay by 0.52 tons, or by 31 per cent, over the unfertilized pastures. As with the amount of grazing secured, there was a trend toward greater yields from year to year, with 1940 yields from unfertilized as well as fertilized pastures distinctly larger than for any other year.

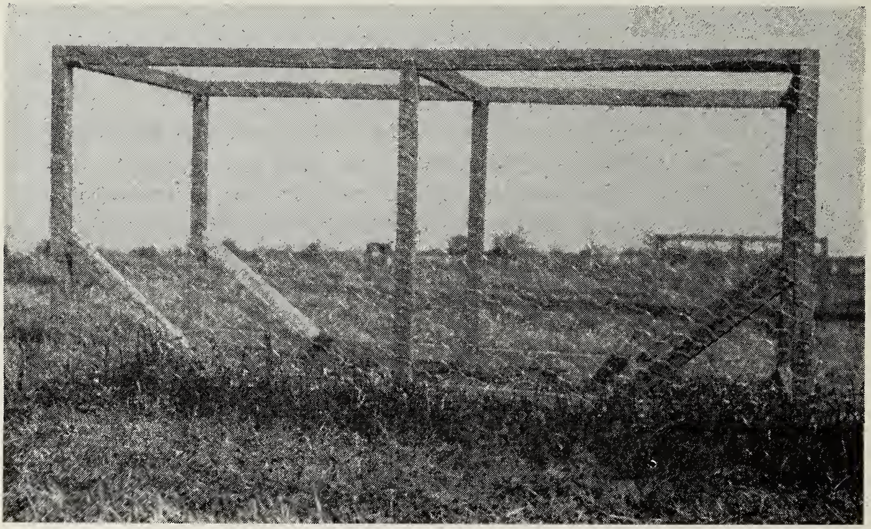

FIGURE 1. Hay Yields Were Secured by Clipping Areas Protected by the Above Type of Cage Located Within Each Part of Each Test Pasture.

Chemical analyses did not reveal any appreciable increase in the calcium content of the hay due to fertilization. There was, however, an increase in the phosphorus content for all years but one, 1939. The four-year average increase in phosphorus (in terms of phosphoric acid, P_2O_5)

TABLE 3. THE EFFECT OF FERTILIZATION ON THE YIELDS AND PHOSPHORUS CONTENT OF HAY.

YEAR	TONS AIR-DRY HAY PER ACRE		PER CENT OF PHOSPHORUS IN HAY*	
	Unfertilized	Fertilized	Unfertilized	Fertilized
1937	.95	1.51	0.37	.42
1938	1.35	1.32	.43	.86
1939	1.61	2.69	.47	.38
1940	2.80	3.27	.54	.63
AVERAGE	1.68	2.20	.45	.56
Average Increase	....	31%	....	24%

*Phosphorus content is given as phosphoric acid (P_2O_5).

was .11 per cent, or 24 per cent more than the average of .45 per cent found in hay from unfertilized pastures.

In general the hay yields were in line with grazing results. The increase in phosphorus content due to fertilization was an encouraging result, for it showed that when cows graze fertilized pastures, they not only receive more feed for a longer period of time, but also receive a feed richer in a mineral constituent that plays a major role in the nutrition of their bodies and in the production of milk. It is probable that other mineral constituents not checked, and organic compounds such as protein and certain vitamins, were also higher in the pastures receiving fertilizer.

RESULTS OF THE INDIVIDUAL TESTS

The Hartsell Test

Improvement of the S. B. Hartsell pasture, in Claiborne Parish, began in the fall of 1936. The test was located on 12 acres consisting of an old pasture and some cultivated land. The soil type was Norfolk fine sandy loam, with an original acidity in terms of pH of 5.8. To prevent erosion, the field was terraced, and later a pond was built in the center of the area. The entire field was plowed and double disked, and two tons of limestone were applied per acre. Also, 350 pounds of 4-12-4 were applied per acre to the south half, a procedure which was followed each October or November throughout the experiment.

Seedings during the first fall consisted of 2 bushels of oats per acre on the old field and 20 pounds of rye grass per acre on the old pasture area. In addition, white Dutch, bur, and hop clovers were seeded over the entire area. In early March of 1937, common lespedeza was also seeded over all the pasture. As a result of these seedings, it was found that rye grass and the hop and white Dutch clovers were doing well in the spring of 1937. The bur clover seeding did not result in a stand.

Besides the fall application of 4-12-4, a 50-pound per acre application of nitrate of soda was made on the fertilized portion during the follow-

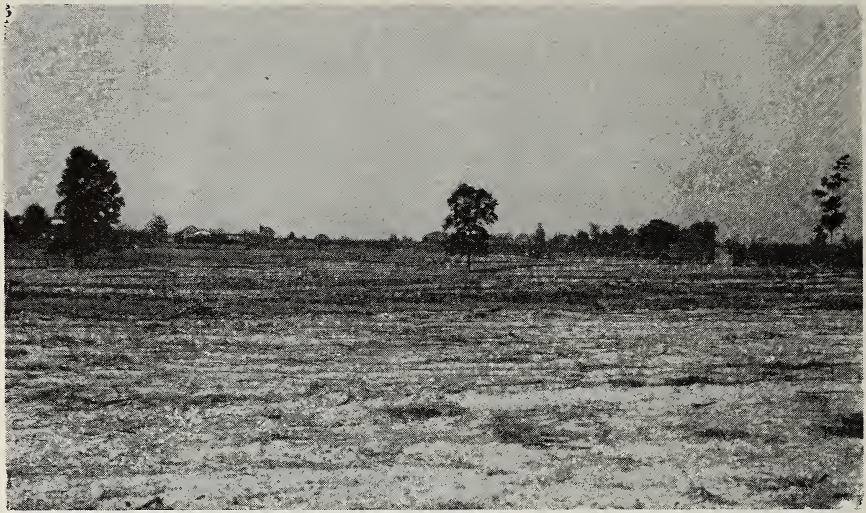

FIGURE 2. THE HARTSELL TEST PASTURE IS SHOWN BEING PREPARED IN THE FALL OF 1936 FOR ITS IMPROVEMENT PROGRAM. NOTE TERRACES IN THE BACKGROUND.

ing May. The effect of fertilization was soon apparent, for clippings of caged areas in June of 1937 gave a yield of 1.2 tons of green herbage per acre from the portion fertilized and 0.7 tons per acre from the unfertilized half. Likewise, in September of that year much more lespedeza and forage of a greener color was found on the fertilized half. Yields of forage in terms of air-dry hay, as well as the yield and value of milk produced are

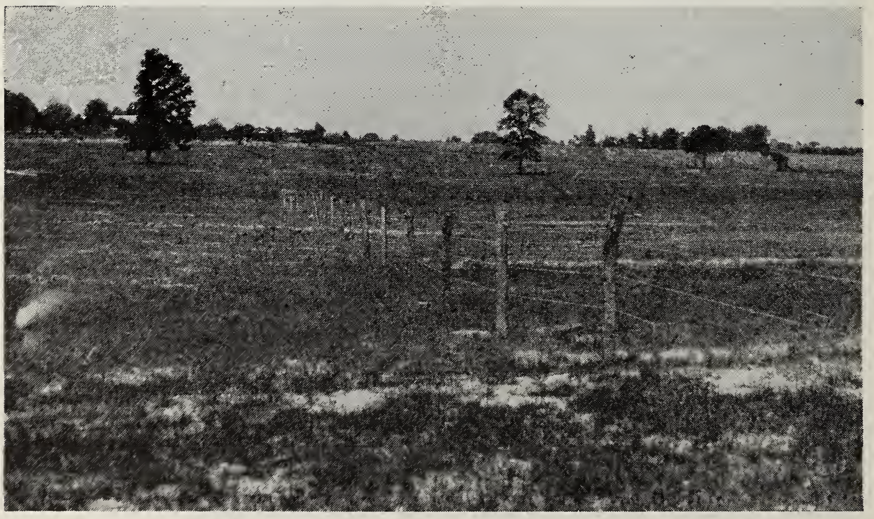

FIGURE 3. THE HARTSELL TEST IN MAY OF 1937. NOTE FENCE DIVIDING FERTILIZED HALF (ON THE RIGHT) AND THE UNFERTILIZED HALF (ON THE LEFT).

TABLE 4. ANNUAL RETURNS FROM FERTILIZED AND UNFERTILIZED PASTURES
(S. B. Hartsell Test)

YEAR	COW DAYS GRAZING PER ACRE		POUNDS MILK PER ACRE		RETURN PER ACRE OVER GRAIN AND FERTILIZER	
	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized
1937	140	223	2,923	5,095	$20.42	$32.58
1938	150	197	3,153	4,234	43.04	50.59
1939	148	334	2,786	6,211	37.90	74.80
1940	258	361	5,185	8,320	70.28	101.74
AVERAGE	174	279	3,512	5,965	42.91	64.93
Average Increase	...	60%	.....	70%	.....	51%

listed by years in Table 4. These results are in line with those secured when the three tests were averaged, except that the per acre returns in terms of milk and return over grain and fertilizer costs are substantially higher than for the other two tests. Part of this difference was due to the high average milk and butterfat records of the herd grazing the test. During one of the years the herd had the highest average butterfat production per cow of any dairy herd improvement association herd in the state.

Since the first year, the management of the pasture has consisted largely

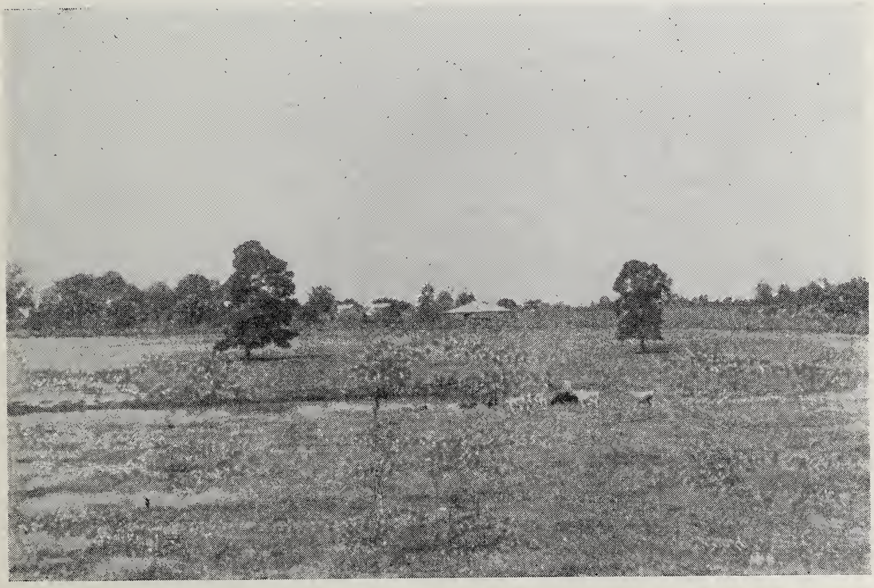

FIGURE 4. HOW THE HARTSELL PASTURE LOOKED IN 1941. NOTE THE HEAVY GROWTH OF PASTURE PLANTS, THE FREENESS FROM WEEDS, THE WATER-CONSERVING POND AND THE MILKING HERD.

of two to four mowings annually to control weeds, rotational grazing to regulate closeness of grazing, and the per acre application of 350 pounds of 4-12-4 in the fall and 50 pounds of nitrate of soda in May. The principal species of pasture plants now in the pasture are Bermuda grass, white Dutch and hop clovers. Part of the general improvement in the pasture has probably been due to the fact that the herd has been receiving a liberal amount of grain, and the droppings from the cows have, owing to the lack of any significant erosion, remained on the pastures to enrich them.

The Moncrief Test

The pasture test on the N. L. Moncrief farm, Lincoln Parish, was located on soil classified as Ruston very fine sandy loam, with an original pH of 6.2. During 1936 the west end of the test area grew a crop of cowpeas and soybeans, which were disked under in October. For the purpose of the experiment, the 15-acre test field was divided into a north half, which was fertilized, and a south half, which remained unfertilized. Thus a portion of the old soybean and cowpea field was left in each half. Lime was applied to the entire field at the rate of 3,400 pounds per acre, terraces were built and a seedbed was prepared by disking and harrowing. A complete fertilizer (4-12-4) was applied at the rate of 350 pounds per acre to the north half prior to disking in October. This same fertilizer treatment was repeated each fall. Likewise, 50 pounds of nitrate of soda were applied to the fertilized half each May.

The seeding for the first fall, 1936, consisted of 2 bushels of oats per acre in September and 3.1 pounds of spotted bur clover, 2 pounds of hop clover, 4 pounds of white Dutch clover, and 15 pounds of rye grass per acre on October 24. On March 1, 1937, the entire area was sown to a mixture of Dallis grass and common lespedeza at the rate of 10 pounds per acre. Oats and rye grass made the greatest showing during early 1937, and there was a noticeably greener color and greater growth on the fertilized half. Clovers were slow in establishing themselves, and the bur and

TABLE 5. ANNUAL RETURNS FROM FERTILIZED AND UNFERTILIZED PASTURES
(N. L. Moncrief Test)

YEAR	COWS DAYS GRAZING PER ACRE		POUNDS MILK PER ACRE		RETURN PER ACRE OVER GRAIN AND FERTILIZER	
	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized
1937.............	72	128	1,224	2,408	$20.92	$33.58
1938.............	67	113	1,279	2,078	26.64	36.76
1939.............	124	181	1.814	2,692	40.11	51.69
1940.............	124	234	2,186	4,299	46.21	86.52
AVERAGE....	97	164	1,626	2,869	33.47	52.14
Average Increase...	...	69%	.....	76%	.....	56%

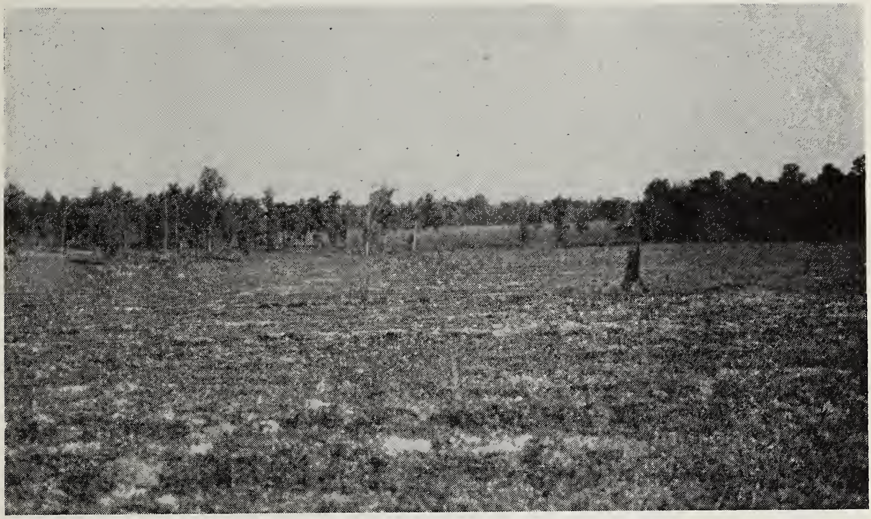

FIGURE 5. The Moncrief Pasture As It Appeared in November, 1936. Note That All But One Stump Have Been Removed.

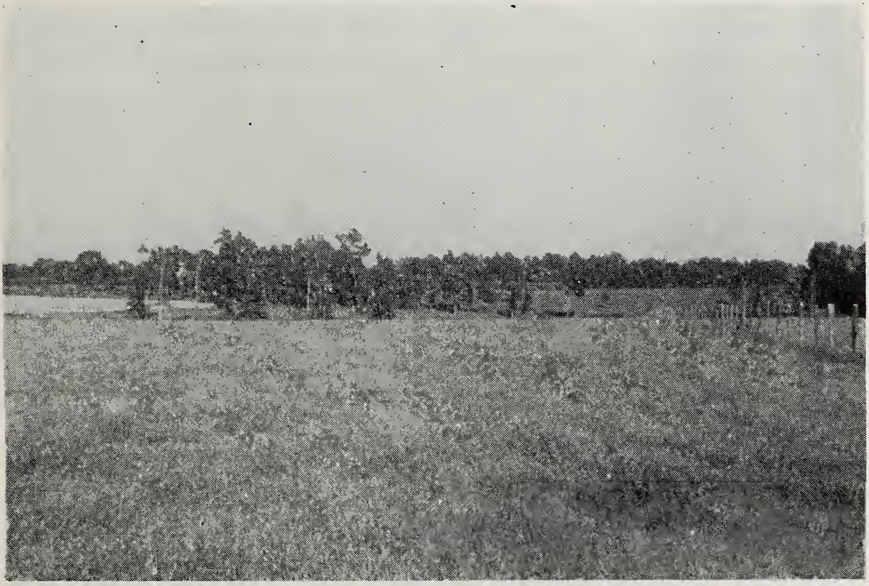

FIGURE 6. The Improved Moncrief Pasture in 1941. Note Heavy Growth of Herbage and the Lack of Weeds. Fertilized Half on Left and Unfertilized on Right.

white Dutch did well only in spots. During the last two years of the test there was an abundance of both hop clover and lespedeza over most portions of the pasture. Bermuda, plus a scattering of Dallis, especially along the valley of terraces, constituted the desirable grass prevalent.

Tabulations relative to yearly yields from the Moncrief test are shown in Table 5. The productivity of the Moncrief pasture was not so high as that of the Hartsell pasture, but the percentage increase due to fertilization was greater for each comparison, the increases being 69 per cent in cow days, 76 per cent in yield of milk per acre, and 56 per cent in returns over cost of grain fed and fertilizer used, all of which exceeded the respective increases shown in the Hartsell test.

The Alford Test

A 9.3-acre tract which had grown cotton for more than 50 years and was retired from cultivation in 1934, was utilized for a pasture test on the B. P. Alford farm near Mt. Herman, in Washington Parish. Cahaba sandy loam was the soil type, and the existing vegetation consisted largely of some carpet grass, common lespedeza and Bermuda grass.

Steps toward improvement of this pasture were started in February of 1937, when one-half of the area was fertilized with a 4-12-4 formula at the rate of 350 pounds per acre. After this first application the same fertilization took place in October or November of every fall, and 50 pounds of nitrate of soda per acre were applied each May to the fertilized half. During the fall application the area was disked, with the blades set at only a slight angle but weighted in order to have them penetrate the sod.

The entire area was first seeded in March of 1937, when 15 pounds of common lespedeza and 6 pounds of Dallis grass were applied per acre to

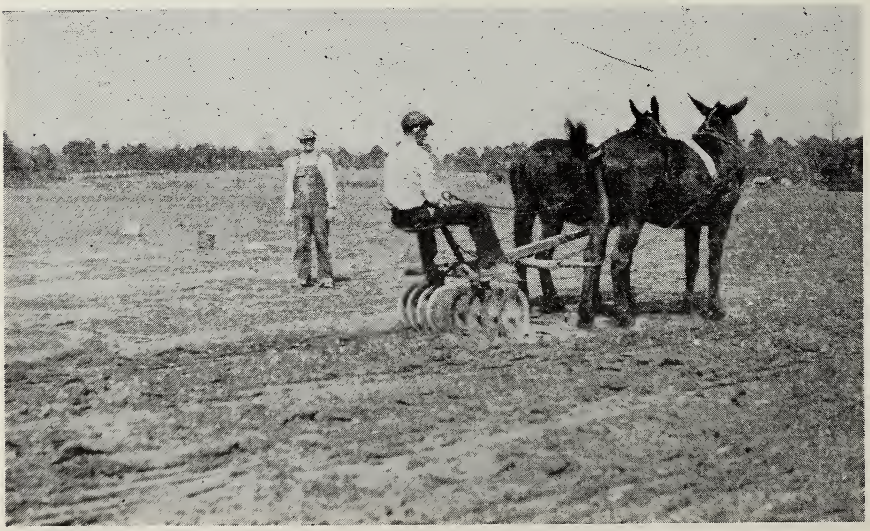

FIGURE 7. Disking in the Fertilizer on Land for the Alford Pasture Test, March, 1937.

the entire test area. The initial seeding gave a good stand of lespedeza but only a scattering of Dallis grass. Growth of the lespedeza and native grasses, from the outset, showed a greener and a greater growth on the fertilized than on the unfertilized half of the area. During October of 1937 another seeding was made, consisting of 2 pounds of hop clover, 2 pounds of white Dutch and Persian clovers mixed, and 20 pounds of Italian rye grass per acre. A good stand of rye grass and some clover resulted. The rye grass seeding was repeated at the time of disking during October of 1938 and 1939.

Yields of pasturage resulting from the procedure followed for this test have not been so great as with the other two tests. Results, as shown in Table 6, however, distinctly favor the fertilized pasture. In an effort to further improve the Alford pasture, the test is being continued and the benefits derived from liming and a more thorough seedbed preparation will be determined.

TABLE 6. ANNUAL RETURNS FROM FERTILIZED AND UNFERTILIZED PASTURES
(B. P. Alford Test)

YEAR	COW DAYS GRAZING PER ACRE		POUNDS MILK PER ACRE		RETURN PER ACRE OVER GRAIN AND FERTILIZER	
	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized
1937	91	124	1,335	1,912	$22.20	$24.30
1938	124	183	2,243	3,272	40.92	52.77
1939	90	121	1,675	2,263	28.30	31.58
1940	132	204	2,307	3,430	43.80	56.42
AVERAGE	109	158	1,890	2,719	33.80	41.26
Average Increase	...	45%	.....	44%	.....	22%

BENEFITS FROM BASIC SLAG APPLIED TO AREAS PREVIOUSLY NOT FERTILIZED

In the fall of 1940, basic slag was applied at the rate of 600 pounds per acre to the previously unfertilized half of each test pasture. The halves receiving the annual application of 4-12-4 and nitrate of soda were treated the same as in the past, with the exception of one test (Hartsell), in which case no fertilizer was applied.

The added response from the previously unfertilized halves as compared to the four-year averages for the test pastures is shown in Table 7. This comparison shows in a convincing manner the extra "kick" that fertilizer gives to permanent pasture. When compared to the average yields of 1937-40, the 1941 yields from both the fertilized portions and the previously unfertilized portions showed a marked improvement. On the basis of cow days, the fertilized areas increased 35 per cent and the previously unfertilized 61 per cent. Likewise, the returns from milk

TABLE 7. THE 1941 RESPONSE OF PASTURES RECEIVING BASIC SLAG COMPARED TO THE FOUR-YEAR YIELD OF FERTILIZED AND UNFERTILIZED PASTURES.
(Average of three tests)

UNIT OF MEASUREMENT	FERTILIZED*		UNFERTILIZED 1937-40, BASIC SLAG IN 1941	
	Av. Yield Per Acre, 1937-40	1941 Yield Per Acre	Av. Yield Per Acre, 1937-40	1941 Yield Per Acre
Cow Days Grazing Per Acre	200	270	127	204
Increase Over Four-Year Av.	......	35%	......	61%
Pounds Milk Per Acre	3,851	4,884	2,342	3,915
Increases Over Four-Year Av.	......	27%	......	67%
Return Over Grain and Fertilizer Costs	$52.78	$71.23	$36.73	$58.63
Increase Over Four-Year Av.	......	35%	......	60%

*One of the fertilized pastures did not receive its usual application of fertilizer for the 1941 season, but had been regularly treated for the previous four years.

over and above cost of grain fed and fertilizer used increased 35 per cent and 60 per cent, respectively. All methods of comparisons, as shown in Table 7, show that the percentage response was about twice as great from the previously unfertilized as from the continuously fertilized test areas. This seemed to be particularly significant in view of the continuous year to year improvement that had taken place in the unfertilized as well as the fertilized pastures. The improvement accomplished without fertilizer was the result of good management, such as reseeding, weed control through mowing, and controlled grazing. When this improvement was supplemented by fertilization, an accelerated improvement took place. In spite of this, it is probable that it will take several years before these pastures yield as much feed as is secured from the pastures which have received the fertilizer four or more years.

SUMMARY AND CONCLUSIONS

1. The economy of improving permanent pastures by good management, fertilization, and reseeding was tested on three actual dairy farms located in three widely scattered dairy regions of the state.

2. Reseeding, frequent mowing, and controlled grazing tended to increase the productivity of pastures from year to year. Annual fertilization tended to accelerate this improvement. See Table 1 and pages 4, 5.

3. Pastures receiving 350 pounds of 4-12-4 fertilizer per acre in the fall and 50 pounds of nitrate of soda in May averaged, on an acre basis, 58 per cent more cow days of grazing, 64 per cent more milk, and 44 per cent more returns over cost of grain fed and fertilizer used than did unfertilized pastures. See Tables 1 and 2 and pages 4, 5.

4. Annual returns per acre over and above cost of grain fed and fertilizer

used averaged for four years $36.73 for unfertilized pastures and $52.78 for fertilized pastures. This gave a $16.05 per acre advantage to fertilized pastures after deducting the same feed costs plus fertilizer costs. See Table 2 and page 5.

5. Yields of air-dry hay from protected areas in the test pastures averaged for the four years 1.68 tons per acre from the unfertilized and 2.2 tons per acre from the fertilized. This gave a 31 per cent advantage to fertilized pastures. There was also a 24 per cent advantage in phosphorus content for fertilized pasture hay. See Table 3 and pages 6, 7.

6. A fifth-year trial with the test pastures in which basic slag was applied to the previously unfertilized pastures resulted in increased yields averaging 61 per cent more cow days of grazing, 67 per cent more milk per acre, and 60 per cent more returns over grain and fertilizer costs than had been secured on an average from those pastures during the previous four years. These increases were about twice as large as were those secured from the fertilized pastures handled in the same manner as for the previous four years. See Table 7 and pages 13, 14.

7. Results of individual tests were in general agreement with the average of all tests (see Tables 4, 5, and 6 and pages 7 to 13) and gave valuable evidence that best results are secured when the following general procedure is followed in improving a pasture.
    (a) Arrange terraces in pasture to control erosion.
    (b) Apply lime to correct acidity.
    (c) Thoroughly prepare seedbed through plowing, disking, harrowing, and rolling or packing with a weighted plank drag.
    (d) Apply fertilizer, especially phosphorus. (If possible, base fertilizer rate and formula on soil analysis.)
    (e) Seed with adapted clovers and grasses, such as white Dutch clover, hop clover, Persian clover, Dallis grass and Bermuda grass.
    (f) Divide pastures so that grazing can be controlled by rotating cattle from pasture to pasture.
    (g) Control weeds by mowing pastures from two to four times a year.
    (h) Have water and shade available in all pastures.

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Feeding and Management of Dairy Calves

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FEEDING AND MANAGEMENT OF DAIRY CALVES[1]

C. H. STAPLES AND D. M. SEATH

IMPORTANCE OF CALF FEEDING AND MANAGEMENT

The dairy heifer can be no better than the inheritance she receives from her ancestors. This fact should encourage Louisiana dairymen to mate their cows to purebred bulls that are backed by high production, and to raise heifer calves only from their better cows.

While inheritance dictates as to the potential possibilities of a heifer, proper feeding and management permit her to develop into a producing cow capable of demonstrating her full worth. Failure to recognize this fact often results in undersized and unprofitable cows.

The expense of raising a heifer from birth to first freshening, while admittedly high is usually nominal compared to the gamble incurred by the man who follows the practice of buying his replacements. Purchased replacements are usually poorer in quality than those raised. Also, such a practice carries the added danger of bringing disease into the herd. The proper use of feeds and the adoption of good management practices will permit dairymen to properly raise their replacements at a cost within their means.

RECORDS ON CALF RAISING AT L. S. U.

During the eight-year period 1928-1935, records were kept on feeds consumed and the feed cost for dairy calves within the L.S.U. dairy herd. In general, the Holstein and Jersey heifers raised in the herd were fed and managed in a practical manner, and an effort was made to get satisfactory growth at an economical cost.

Young calves were allowed to secure the first milk of their mothers (colostrum) by sucking the first 24 hours and then by being hand-fed with their milk for at least the next 48 hours. The monthly consumption of milk fed was secured from a summary of the weighted daily amounts fed. A complete record of the individual amounts of grain and roughage fed was not kept but was determined from records kept on a smaller lot of similar sized heifers. The actual feed costs were determined and have been published,[2] but in this publication any reference to costs will be based on standard feed prices in order to avoid apparent discrepancies due to price fluctuations from year to year during the course of the experiment. Similar fluctuations are experienced by individual dairymen. There are also variations from farm to farm depending on the feed grown, type of farm, et cetera.

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[1] and [2] Much of the data concerning costs of raising calves are taken from Louisiana Agricultural Experiment Station Circular 9, *Costs of Raising Dairy Calves,* by C. H. Staples and R. H. Lush, 1934.

The Preliminary Trial

Three groups of animals consisting of six Holstein calves each were used for a short test during the fall of 1931. Three levels of milk feeding were compared. Group I received 9 pounds of milk per day and was fed liberally on a grain mixture containing 25 per cent skim milk powder. Calves in Group II received 6 pounds of whole milk daily and the same grain mixture as those in Group I. In most cases calves were denied liquid milk after 60 days, but in order to get good results exceptions were sometimes made to this rule. The calves in Group III were handled and fed in the regular manner and received an average of around 13 pounds of milk daily. The results of this trial are shown in Table 1.

TABLE 1. MINIMUM WHOLE MILK TEST

TO 6 MONTHS OF AGE	Group II 6 lbs.	Group I 9 lbs.	Group III 13 lbs.
Days fed whole milk	56	48	65
Pounds whole milk	408	458	835
Pounds skim milk	812	543	1878
Pounds skim milk powder	128	135	66
Pounds grain	389	404	363
Barn feed cost*	$22.84	23.01	33.59
Average weight at 6 months	284	298	308

*Feed prices standardized per cwt: Whole milk, $2.00; skim milk, $0.50; grain, $1.25; skim milk powder, $4.50; silage, $0.20; hay, $0.75.

These three methods of feeding in all cases produced heifers with average weights below the standard of 355 pounds found for six-month-old heifers in Missouri, Kansas and Iowa.[3] The saving in cost of feed for Groups I and II over Group III, however, caused the adoption of a calf feeding program slightly more liberal than that used for Group I, yet decidedly less expensive than was used in this preliminary trial for Group III. One change was to feed slightly more milk during the early life of the calf than was practiced with Group I.

An Eight-Year Comparison

As shown in Table 2, the calf feeding practices for the University herd changed during the period 1928-1935. In general, there was a reduction in the amount of whole milk fed and an increase in the amount of grain and hay fed. There was also some increase in the amount of skim milk powder fed, with a tendency to increase its use during periods when small quantities of liquid skim milk were available and when the powdered milk was relatively cheap. The skim milk powder is considered a good substitute for liquid skim milk when it can be purchased for less than ten times the value of skim milk. There was an ever-increasing demand for milk from the University herd, and the skim milk powder greatly reduced the amount of liquid milk needed for calves, thus helping to supply this demand. Louisiana dairymen who sell whole milk are also in need of good substitutes for liquid milk in their calf feeding operations.

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[3] Ragsdale. Missouri Agricultural Experiment Station Bulletin 336, 1934.

TABLE 2. CHANGES IN FEED CONSUMPTION FOR CALVES, 1928-1935

FEED PER CALF TO 1 YEAR OLD	1928	1929	1930	1931	1932	1933	1934	1935
No. of heifers	26	33	27	27	47	43	55	48
Days fed whole milk	103	91	73	68	48	78	73	58
Days fed skim milk	161	220	188	156	206	193	177	147
Pounds whole milk	1,009	909	840	702	563	902	884	672
Pounds skim milk	1,862	2,656	2,108	2,068	1,044	2,182	1,022	1,867
Pounds skim milk powder	3	66	74	119	174	67	76	83
Pounds grain	390	752	630	805	647	508	243	584
Pounds hay	374	413	335	582	451	314	345	411
Pounds silage	219	269	368	392	157	33	134	141
Barn feed costs*	$37.75	47.47	41.84	43.52	33.89	40.99	32.23	37.47

*Feed costs based on prices listed below Table 1.

Feed Costs for Jerseys

The summary of feed consumption and costs for raising Jerseys, as presented in Table 3, illustrates the average results for the years 1928 to 1935 inclusive. Data on heifers to freshening reveal that whole milk was fed an average of 86 days and that skim milk was fed 222 days, with the daily amounts being 10 pounds and 11 pounds, respectively. Amounts of grain fed daily averaged 1.3 pounds to 6 months of age, approximately 2.3 pounds between the ages of 6 and 12 months ,and approximately 1.0 pound between 12 months and freshening (32 months).

Hay consumption averaged a ton, silage slightly less than a ton (1,842 pounds) and grain 1,217 pounds for heifers to time of freshening. Most of the hay, silage and grain was consumed after animals attained 6 months of age, while very little milk was consumed after that date.

Total barn costs of feeds averaged $69.23 to time of freshening, while those costs at 6 months of age were 40 per cent, and at 12 months of age 60 per cent of this total. This illustrates that about 50 per cent of the barn cost of raising a heifer is incurred by the time the heifer reaches an age of approximately 8 months. Beyond this age, pasture materially decreases the necessity for barn feeding.

TABLE 3. FEED CONSUMPTION AND COSTS* OF RAISING JERSEY HEIFERS (BORN 1928-1935)

ITEM	To 6 Months	To 12 Months	To Freshening
Number of heifers	115	109	60
Days fed whole milk	79	78	86
Days fed skim milk	103	205	222
Pounds whole milk	794	807	858
Pounds skim milk	1,067	2,186	2,449
Pounds skim milk powder	43	120	118
Pounds grain	234	656	1217
Pounds hay	190	433	2002
Pounds silage	35	220	1842
Cost of whole milk	$15.98	$16.14	$17.16
Cost of skim milk	5.34	10.93	12.24
Cost of skim milk powder	1.94	5.40	5.31
Cost of grain	3.04	8.53	15.82
Cost of hay	1.42	3.25	15.02
Cost of silage	.07	.44	3.68
TOTAL BARN COSTS*	27.79	44.69	69.23
Per cent of cost to freshening	40	65	100

*Costs of feeds are based on prices listed below Table 1.

Feed Costs for Holsteins

Costs of raising Holsteins, as presented in Table 4, are very similar to those for Jerseys. In general, the Jersey heifers received whole milk and skim milk for a longer period than did the Holsteins. This is one reason why the costs of raising Holsteins to 12 months and to freshening are slightly less than for Jerseys. The Holsteins received, between birth and freshening, an average of 12.2 pounds of whole milk per day for 68 days, and an average of 12.9 pounds of skim milk per day for 169 days.

TABLE 4. FEED CONSUMPTION AND COSTS* OF RAISING HOLSTEIN HEIFERS (BORN 1928-1935)

ITEM	To 6 Months	To 12 Months	To Freshening
Number of heifers	203	198	118
Days fed whole milk	67	67	68
Days fed skim milk	110	167	169
Pounds whole milk	784	792	827
Pounds skim milk	1,284	1,904	2,175
Pounds skim milk powder	61	83	60
Pounds grain	248	568	896
Pounds hay	186	331	2589
Pounds silage	52	174	1934
Cost of whole milk	$15.68	$15.84	$16.54
Cost of skim milk	6.42	9.52	10.88
Cost of skim milk powder	2.74	3.74	2.70
Cost of grain	3.22	7.38	11.65
Cost of hay	1.40	2.48	19.42
Cost of silage	.10	.36	3.87
TOTAL BARN COSTS*	29.56	39.32	65.06
Per cent of cost to freshening	45	60	100

*Costs of feeds are based on prices listed below Table 1.

The grain fed daily averaged 1.4 pounds to 6 months, 1.8 pounds between the ages of 6 and 12 months, and 0.5 pounds between 12 months of age and freshening (averaged 36 months). Obviously most of the grain feeding after the heifer attained an age of 12 months occurred during the winter months.

The amount of hay fed to age of freshening averaged 2.25 tons (2,589 pounds), silage slightly less than a ton (1,934 pounds), and grain less than one-half ton (896 pounds). Of the total barn cost to date of freshening (which totaled for Holsteins $65.06), 45 per cent came during the first 6 months, and 60 per cent during the first 12 months. Thus, for Holsteins 50 per cent of the barn cost was incurred during the first 7 to 8 months.

How Weights of Heifers Compared to Normal Weights

A portion of the dairy heifers on which feed records were kept were weighed at various periods during their growth, and the results, as well as the Missouri-Kansas-Iowa standard, are shown in Table 5.

TABLE 5. AVERAGE WEIGHTS OF DAIRY FEMALES

AGE	JERSEYS			HOLSTEINS		
	No.	L. S. U. (pounds)	Standard* (pounds)	No.	L. S. U. (pounds)	Standard* (pounds)
Birth	63	46	53	74	71	90
6 months	63	203	243	74	280	355
12 months	15	362	450	13	500	632
24 months	10	637	733	10	860	1069
3 years	21	820	855	14	993	1165
4 years	14	861	897	15	1065	1232
5 years	11	854	937	10	1120	1330
Over 5 years	23	912	...	29	1240	....

*Standard weights are those reported by Ragsdale for Missouri, Kansas and Iowa. Mo. Agri. Exp. Sta. Bul. 336, 1934.

Compared to the standard, the Jerseys were smaller by 7 pounds at birth, 88 pounds at one year, 35 pounds at three years and 83 pounds at five years of age. The 23 Jerseys of over 5 years in age lacked only 25 pounds of being as heavy as the 5-year-old standard. Possibly the University Jerseys were slightly slower in reaching maximum weight than were those used for the standard.

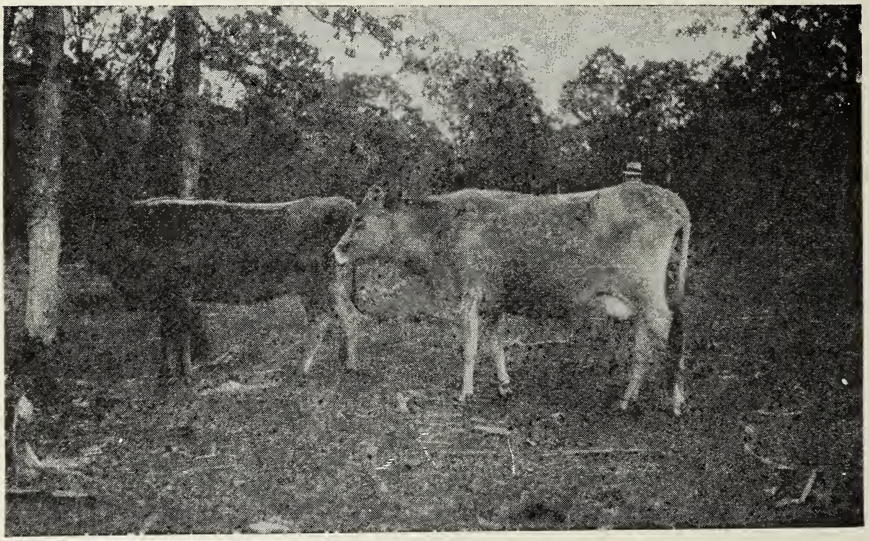
Holsteins lacked 19 pounds of being as heavy as the standard at birth. They were 132 pounds less than the standard at one year, 172 pounds under at three years, and 210 pounds less at five years of age. It seems evident that the University Holsteins were much smaller when compared to the standard than were the Jerseys.

One of the explanations of why both the Jersey and Holstein heifers had weights less than the standard throughout their development is that they did not inherit factors for large size to the same extent as those entering into the standard. As evidence of this, the birth weights of both breeds averaged less than the standard, and it has been shown[4] that large animals normally have large calves and that, except for extreme conditions, the feeding of the cow during pregnancy does not materially affect the weight of her calf.

SUGGESTIONS ON FEEDING AND MANAGEMENT OF DAIRY CALVES

Feeding the Mother

Proper feeding and management of the dairy calf starts with the mother. A calf born weak of an extremely thin and emaciated mother seldom has a chance to develop into a healthy animal of normal size. A regular breeding dairy cow should drop a calf every 12 months. Such a cow should be in production 10 months and dry two months. Roughages such as green succulent pasture and legume hay will do much to furnish the proper amount of minerals and protein to the cow prior to freshening. Just enough of a balance grain mixture should be fed during the dry period to put the pregnant cow in good condition, exhibiting considerable bloom.



These Cows Were Suffering from a Lack of Phosphorus and Calcium. Such Cows Do Not Normally Drop Strong Healthy Calves

A reduction in the amount of the heavy grains fed (such as corn) should be made the last 10 days prior to freshening in order to avoid excessive udder swelling. Wheat bran and ground oats are excellent feeds to give at this time, as well as immediately following calving.

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[4] Peterson, *Dairy Science*, J. P. Lippincott Co., pp. 267-268, 1939.

Care at Calving Time

Immediately after birth it is best to treat the calf's navel with iodine or mercurochrome and then rub the cord dry with powdered alum. This precaution will do much to prevent navel infection.

The first milk of the fresh cow is called colostrum, and it is most essential that this be the first food of the new-born calf. Colostrum milk has been found to contain from 10 to 100 times as much vitamin A as ordinary milk. It has also been found to contain a large quantity of constituents which help the new-born calf to ward off disease. An early experiment by Little and Smith[5] demonstrated the value of colostrum milk. In a trial all ten calves receiving colostrum milk survived, while eight out of 12 not getting colostrum died. They explained that the colostrum milk acted as a protection against bacterial infection. The udder and teats of the mother should be thoroughly cleaned so that the calf can have the essential colostrum milk as free from dirt and harmful bacteria as possible.

Feeding the First Milk

Colostrum milk should be fed to the calf for the first three to four days. This is the normal period that the fresh cow produces colostrum milk. To see that the calf gets this milk, it is sometimes best to leave the calf with the mother and to make sure that the calf nurses. Good results can also be secured by taking the calf entirely away from the mother and hand feeding the calf. The separation is often made the second day and after the calf has nursed several times. Early separation of the cow and her calf is often best for both. It helps in regulating the amount of milk fed, thus helping to prevent digestive trouble in the calf, and it keeps the calf from confining its nursing to one or two teats of the cow which, unless prevented, results in a temporary and sometimes a permanent unbalancing of the cow's udder. An early separation before being together too long also causes the animals to miss each other less, thus eliminating some of the causes of nervousness and anxiety. In hand feeding, care should be taken to use a clean sterile pail and to feed the milk immediately after it has been milked and while it is still warm.

How Much Milk to Feed

Care should be taken concerning the amount of milk fed to calves. All milk fed should be either weighed or accurately measured. Too often more milk is fed than is good for the calf. A good rule is "to feed daily approximately 10 per cent of the calf's live weight." This means that at birth a Jersey calf would receive daily from 5 to 6 pounds and a Holstein calf from 7 to 8 pounds. A quart of milk weighs 2.15 pounds, so the Jersey calf at birth would receive between 2.5 and 3.0 quarts and the Holstein from 3 to 4 quarts per day. One-half these amounts should be fed at each feeding, and any increase made in quantity fed should be made gradually and in step with the increase in the body weight of the calf. Better results have been secured where small calves have been fed three times daily, with one-third of the daily amount being fed at each feeding. Under such a plan slightly less trouble is encountered with digestive disturbances in calves. Obviously it is best to milk the mother three times daily so that the milk will be fresh at each feeding.

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[5] *Jour. Am. Medicine,* 36:181-198. 1922.

Feeding Skim Milk

Because of the economy involved, it is usually advisable to use liquid skim milk, skim milk powder, or good milk substitutes in place of a part of the whole milk, beginning when the calf reaches three weeks of age. The change at this period must not be sudden and should occupy a period of at least one week, and preferably longer. In no case should a calf be taken off whole milk before it has learned to eat grain and hay. The butterfat removed from milk must be replaced in the ration by the grain and hay if the calf is to receive a sufficient amount of energy and vitamins. Skim milk should be fed at the same rate as whole milk, but the upper limit for older Jersey heifers should be 14 pounds and for Holsteins 16 pounds per day. The older heifers will thrive well on less than the maximum amounts but can make good use of the 14 or 16 pounds when there is an excess of skim milk to be utilized.

Feeding Skim Milk Powder

Whenever skim milk powder sells for less than 10 times the price of liquid skim milk, it is an economical feed for dairy calves. It can be fed either by mixing one pound of the powder with nine pounds of warm water, or by having it constitute from 10 to 25 per cent of the grain ration. Experience has shown that the powder is more palatable when mixed with water, but that little trouble is experienced with feeding it dry in the grain mixture of older calves.

Calf Meals

Various commercial and home-mixed calf meals are in use by whole milk dairymen in their efforts to cheapen the cost of raising calves. Few milk substitutes have proved 100 per cent efficient but several have given satisfactory results. Cornell University[6] in an experiment with several mixtures, secured particularly good results using the following procedure:

1. Whole milk feeding schedule (Holstein calves)

Leave cow with calf at least one day and not more than four days
4th to 7th day—maximum amount 8 pounds daily
second week—maximum amount 9 pounds daily
third week—maximum amount 10 pounds daily
fourth week—maximum amount 9 pounds daily
fifth week—maximum amount 7 pounds daily
sixth week—maximum amount 6 pounds daily
seventh week—maximum amount 4 pounds daily
eighth week—no milk
Total whole milk allowed—350 pounds. (Jersey calves would be fed about two-thirds the amounts listed above.)

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[6] Savage and Crawford. New York Experiment Station Bulletin 622. 1937.

2. A 22 per cent dried skim milk starter

(To be fed until calf is 16 weeks of age)
25 per cent ground yellow corn
30 per cent rolled oats
15 per cent wheat bran
8 per cent linseed oil meal
22 per cent dried skim milk
(Feed with clover and grass hay)

3. Heifer concentrate mixture

(To be fed after calves are 16 weeks of age)
30 per cent ground yellow corn
30 per cent ground oats
30 per cent wheat bran
10 per cent linseed oil meal

The above feeds and feeding schedule were found by the New York workers to produce satisfactory growth and gains. Their work did show that when the calf starter contained 40 per cent skim milk powder, the calves made slightly greater gains, but that the additional cost of such increased gains did not justify the use of the additional amount of dried skim milk. It is the authors' opinion that soybean oil meal or cottonseed meal will make a satisfactory substitute for linseed oil meal in the above concentrate mixtures.

Oregon[7] tried the following three mixtures:

	No. 1	*No. 2*	*No. 3*
Ground oats	150 lbs.	150	120
Ground yellow corn	150	150	130
Wheat bran	150	150	150
Linseed oil meal	50	50	50
Soluble blood flour	50	..	..
Dried skim milk	..	50	100
Steamed bone flour	5	5	5
Salt	5	5	5
Total	560	560	560

All three of these mixtures proved satisfactory. The calves at first were slightly under the normal for growth but they later attained normalcy. The Number 3 meal gave slightly better results than the other two, and this was attributed to its high percentage of skim milk powder. All three of the calf meals were fed dry, and the calves ate sufficient amounts of them to supply their needs.

Whey as a Calf Feed

Dairymen living near a cheese plant often make use of whey as a calf feed. When ever this is done, recognition should be given to the differences between skim milk and whey. The average analyses of these two feeds follow:

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[7] Jones, Brandt and Wilson. Oregon Agricultural Experiment Station Bulletin 290. 1931.

Analysis of Skim Milk and Whey

Nutrients	*Skim Milk (Per Cent)*	*Whey (Per Cent)*
Water	90.50	93.07
Fat	0.10	0.34
Protein	3.57	0.93
Sugar	4.95	5.00
Ash	0.75	0.60

From these analyses it is evident that the grain mixture used as a supplement to whey should differ from that used with skim milk. In particular, the grain mixture must be higher in protein to supplement whey than when fed with skim milk. The Wisconsin Station recommends using 40 per cent of soybean oil meal or linseed oil meal in the grain mixture and suggests the following mixture:

30 pounds	ground corn
30 pounds	standard wheat middlings
40 pounds	soybean oil meal

It is probable that cotton seed meal as well as linseed oil meal can replace the soybean oil meal in this ration.

Buttermilk for Calves

Good clean buttermilk makes a satisfactory substitute for skim milk in the dairy calf's ration. Buttermilk has about the same analysis as skim milk and when fed either sweet or sour gives results comparable to skim milk. Care should be taken that the buttermilk comes from clean storage tanks and that either the cream from which it came or the buttermilk itself has been pasteurized. These precautions will often prevent digestive trouble with calves and prevent bringing infectious diseases into the herd.

Grain for Calves

Dairy calves should be taught to eat grain as soon as possible. This can be done at an early age by stantioning the calf prior to the feeding of milk and by feeding the grain immediately after the calf has finished its milk. To accustom the calf to the taste of the grain, a handful of the grain should be placed in the calf's mouth as soon as the milk has been drunk. Soon the calf will take the grain of its own accord. Stantioning the calf, plus the feeding of grain, not only helps teach the calf to eat grain, but also helps to prevent calves from developing the habit of sucking each other after finishing their milk.

While the calf is less than six months of age it can thoroughly digest whole grains such as corn and oats. These grains are especially palatable to the calf and are satisfactory as a concentrate as long as the calf is receiving milk. Corn and bran are also satisfactory at this period.

Older calves should have their grain crushed but not finely ground.

Some suggested rations that will meet the needs of most calves until they reach the age of 8 to 10 months of age follow:

1. Crushed oats or corn, or both
2. 300 pounds crushed corn
   100 pounds bran
3. 100 pounds crushed corn
   100 pounds crushed oats
   100 pounds bran

Along with all of these rations the calves should have free choice of a mineral mixture consisting of equal parts of salt, bone meal, and oyster shell flour.

Hay for Dairy Calves

Young calves should have access to hay at all times. A calf will start eating sparingly of hay when only a very few weeks old, and will gradually increase amounts eaten as the capacity of its paunch develops.

Hay of good quality furnishes calves with excellent bone-building material (calcium) and nutrients for growth (protein and vitamin A). Legume hay, such as clover, lespedeza, and alfalfa, has been proved to be more beneficial to calves than grass hay, but in order to avoid scours in young calves legume hay must either be fed sparingly or in combination with grass hay. Sudden changes in quality of hay should be avoided; otherwise there is danger of scours.

Silage for Calves

Experimental work indicates that calves receiving milk derive but little benefit from silage and that the very young calf may actually have digestive troubles due to silage. Hay is the preferable roughage for the calf under four months of age. Calves older than this can benefit from small quantities of fresh silage of good quality.

Pasture for Calves

As with silage, the calf less than four months of age often does better when hay rather than pasture constitutes its roughage. The very young calf is usually receiving two high-moisture feeds when allowed on pasture. These are, milk, which averages 87 per cent water, and succulent pasture, which may average as high as 90 per cent water. Thus the small stomach of the calf can be full, and yet the consumption of total dry matter can be surprisingly low. Under these conditions, a young calf often has little appetite for the more concentrated feeds such as grains and hay. As a result, scours often occur and growth is retarded. Even though the baby calves should not be allowed on pasture, they should have access to a lot where they can be exposed to sunlight and can secure exercise.

Calves over four months of age can usually make good use of pasture. To prevent retarding of growth, however, it is advisable to continue the feeding of some grain. Calves should at first be allowed on pasture only one-half of each day until they accustom themselves to the change. It is only advisable to continue the feeding of hay until the calves no longer desire it. An effort should be made to provide supplemental pastures such as oats, lespedeza, Sudan, and sweet potato vines so as to fill in the gaps when the permanent pasture is dry or short.

The Proper Care and Feeding of Calves and Yearlings Is an Essential in Building a Profitable Dairy Herd

Housing the Calf

The housing facilities for calves need not be elaborate as long as they are clean, dry and have protection from air drafts and moisture. The first essential is to have the quarters free from infestious diseases and parasites common on calves. If quarters can be moved—such as a small barn on skids—it is advisable to move to a new location once a year. When the quarters cannot be moved, the floor should be thoroughly cleaned and then generously sprinkled with hydrated lime prior to bringing new calves into the quarters. The walls and partitions should also be disinfected at least twice a year. The calf pens can best be built of solid partitions to avoid drafts. Such pens should have the manure removed often and should be kept well bedded.

FEEDING AND MANAGEMENT OF YEARLING HEIFERS

Yearling heifers require little extra feed or care when allowed access to good pasture in summer and good roughage, such as legume hay and silage, in winter. It is during this period of growth that the heifer develops her capacity to handle large quantities of roughage, and it is desirable to feed only enough concentrates, such as the milking herd's mixture, to tide the heifers over the periods of extremely short pasture and to maintain the heifers in a relatively good, but not fat, condition. The heifer, as is the case with the milking herd, can make good use of supplemental pastures such as oats, Sudan, lespedeza, and sweet potato vines

GOOD PASTURE IS THE BEST AND THE CHEAPEST FEED FOR YEARLING DAIRY HEIFERS

during periods when permanent pastures are less productive. In order to insure an adequate amount of essential minerals for growth, the heifers should have free access to a mineral mixture consisting of equal parts common salt, steamed bone meal, and finely ground oyster shell (or limestone.)

The time to breed a heifer should depend on her size and age. In general, a well-grown Jersey heifer should freshen between 24 and 26 months of age. In contrast to this, it might be best to have a Jersey heifer which is small for her age freshen after she reaches 30 months of age. Holstein heifers mature a little slower than do Jerseys and should freshen when they are about four months older than Jerseys. The approximate age to breed well-grown heifers follows:

Jerseys	15 to 17 months
Guernseys	17 to 19 months
Holsteins	19 to 21 months

If possible, heifers should be bred to freshen in the fall rather than in other seasons of the year. Some of the reasons in favor of fall calving follow:

1. Fall freshening cows are in the peak of production during a normal period of milk shortage and in the spring get a stimulation in their production from spring pasture. As a result, they have a higher yearly production than do spring or summer freshening cows and their product usually averages higher in selling price.

2. Fall calves have an opportunity to go through their barn feeding period during winter months and are able to go onto pasture when spring arrives. This insures better growth and a lower cost of raising calves.

3. The fall calf, during its first few months, is bothered less by flies and bacteria, so prevalent in warm weather, than is the calf born in the spring or summer.

One or two months prior to her freshening date it is a good practice to move the heifer into the milking herd so that she may be fed along with the herd and may adjust herself to the new environment, and, as a result be less nervous after freshening. It is desirable to have the heifer in good condition (almost fat) when she freshens. Such a heifer produces more heavily after calving and is less retarded in her growth during the lactation than is the heifer that freshens in a thin condition. The feeding of the heifer 10 days prior to and immediately after calving should be confined to roughage and only a small quantity of a light concentrate such as wheat bran and ground oats. This procedure helps prevent excessive udder swelling.

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Observations and Studies on The Peat Deposits of Louisiana

By

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OBSERVATIONS AND STUDIES ON THE PEAT DEPOSITS OF LOUISIANA

W. R. Dodson*

The fact that there are large deposits of peat in Louisiana has been known for some time but very little definite information has been available in regard to the extent or the depths of these deposits or to the kind or kinds of peat in the different ones. Besides the possible use of the peat in industry or in agriculture, there are many interesting problems in regard to the origin and nature of the deposits. Certain of these have for a considerable period held the interest of geologists, botanists, and soil technologists because the peats involved seemed to be different from most peat deposits.

Some years ago the writer became interested in the peat deposits of Iberia and St. Martin parishes. There the formations are found in the Grand Marais in the vicinity of New Iberia and Jeanerette and in an area surrounding Lake Tasse. The peat in these formations was found to have been formed mainly from plants that belong to the genus *Sagittaria.* While this genus is known to have a wide distribution in undrained lands, it does not appear that it has been reported previously as a dominant in peat formation. When a preliminary report on these studies was submitted to the Director of the Agricultural Experiment Station for publication, he requested that trips be made to other peat deposits of the State to determine their botanical origin and probable economic value.

From observations made on a few exploratory trips it became evident that the peat deposits of the extreme southern portion of Louisiana were very great. Publication of the first report on Iberia and St. Martin parish formations was deferred in the hope of developing a report for the entire State. Funds have not been available for making extensive surveys, but since the exigencies of war have stopped the importation of peat from European countries, and interest in the development of our own varieties of that product has increased, this report, though very incomplete, is now submitted for publication. It may be considered as a progress report and it is hoped that it may stimulate interest in the future development of surveys for the determination of full knowledge of our peat deposits.

This report is being presented in three sections: Section I, a discussion of peat, including its use and importance. Section II, a discussion of the peat areas of South Louisiana. Section III, the Sagittaria peat of the Grand Marais and Lake Tasse areas.

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SECTION I. PEAT, ITS IMPORTANCE AND USE

Commercial Importance of Peat

During the past several years the market demand for a good quality of peat for horticultural uses in the United States has exceeded supplies, and the imports have generally been greater than the domestic production. In 1939 the imports of peat moss for consumption in the United States amounted to 78,611 short tons, valued at ports of entry at $1,204,883.00. "Peat moss" is the trade name of the variety of peat that is formed from plant populations in which sphagnum moss predominates. The domestic production of all varieties of peat for the same year was 55,483 short tons, valued at $362,066 at point of production. Imports plus production therefore amounted to 134,094 tons, valued at $1,566,949. The domestic production for 1940 was increased to 70,097 tons, or 26 per cent; and in value to $516,865, or 43 per cent over 1939[1].

The British blockade of Germany has almost eliminated the item of peat moss from the list of articles imported into the United States because Germany, Netherlands, and Sweden were the sources of by far the greater part of our imports. In 1939 the imports from Germany were 28,127 tons, valued at $389,597. In 1940 the figures decreased to 41 tons valued at $340. Many orders for peat moss in that year were never filled. While the increased production of domestic peat moss and the use of other varieties of peat and of sugarcane bagasse from Louisiana have relieved the situation somewhat, there still seems to be an unusual opportunity to establish a much more extensive use of domestic peats in the United States. Many states have been using a relatively large amount of imported peat moss, and a supply of a satisfactory substitute of domestic origin would be welcomed. The extensive deposits of several varieties of peat in Louisiana may become an important natural resource if commercial uses can be found for them.

The following quotation from Joseph A. Corgan, author of the Chapter on Peat for the *Minerals Yearbook Review of 1940* is of interest: "The loss of foreign supplies of peat moss has doubtless inconvenienced former users of that product materially; on the other hand, it presents an opportunity for United States producers of moss peat to capture a share of this market."

Varieties of Peat

There are great differences in the characteristics of peats of different origin. These differences in color, texture, density, chemical composition, etc., largely determine their economic value. A specific variety of peat may be well suited for one purpose, while another variety might be preferred for another use. A variety of peat formed from forest vegetation would probably be superior to one formed from succulent plants if the product was to be used as fuel, while the appraisement of values would be reversed if the peat was to be used for soil improvement, or other uses in which the capacity to absorb liquids was a primary requisite.

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[1] All the statistical data on peat production and imports not otherwise accredited are from *Minerals Yearbook Review* of 1940, United States Department of Interior, Bureau of Mines.

The texture, density, combustible content, water absorption capacity, and some other qualities of peat are largely determined by the corresponding qualities of the plants that gave rise to it. These qualities are more or less closely correlated with the botanical classification of plants. Since the processes of decay and disintegration are arrested in peat before the cellulose structures are broken down, one may, generally, compare the structural elements of the peat with those of plants of known botanical classifications, and thus determine the names of the parent plants involved, or at least determine the genera to which they belong.

In general, the flora of a specific region may be very different from that of another region in another latitude and climate, and yet the environmental conditions in both regions may be favorable to peat formation. The resulting products would probably be as unlike in many respects as are the plant populations. The peat of Minnesota, where almost half the total peat resources of the United States are located, may be different from peat formed in Louisiana.

Uses of Peat and Muck

In some countries, especially in northern and northwestern Europe and the British Islands, peat is an important commercial commodity, used primarily for fuel, but to some extent for other purposes, including soil improvement, bedding for domestic animals, and packing material for storage and shipment of bulbs, nursery stock, fragile articles, etc. Some progress has been made in the utilization of some grades of peat in the manufacture of building ply-board, craft paper, insulating material, distillates, residual carbons, and other products. The possibilities of peat in industry are discussed in Bulletin 253, Bureau of Mines, U. S. Department of the Interior.

In this country, the principal use of peat in the past has been for improving the physical condition of soils that are used for horticultural and floricultural enterprises and for surface mulching of special plants in lawns, parks, and gardens. Some varieties are also used as absorbents of fluids and deodorization of floors of poultry plants and for bedding in animal cages and stables.

The possible use of peat in soil conservation should also be considered. Large sums of money are being paid to farmers from the public treasury as a subsidy for plowing under cultivated crops for soil improvement. It is not anticipated that this practice will go on indefinitely. Crops that could be used for hay have a money value as feed for livestock that would exceed the cost of chemical fertilizer and peat that would give equal soil improvement. In 1933, A. P. Dachnowski-Stokes[2] voiced the sentiment entertained by many as follows: "The need of organic matter for soil improvement creates a problem that becomes increasingly acute. By far the most valuable constituent of a soil is the organic matter, and depletion of soil humus has become an important factor in impoverishing cultivated soils and subjecting them to erosion. The destruction and loss of soil organic matter by tilling, leaching, and other active agencies is taking place much more rapidly than it was accumulated. A deficiency in soil humus, already deplorable in long-established farming regions, cannot continue without imperiling the most vital resource of the nation.

"As a source of organic matter, the better grades of peat play a significant part in modifying the physical, chemical, and biological properties of mineral soils, and in making them more favorable for the growth of plants. Different kinds of peat are available in considerable quantities in the United States but are not uniform in composition and properties. The relative value of various peat materials in the preparation of desirable composts has been studied by many investigators. The value of peat in mixed fertilizer, or in composts with other plant residues and a variety of animal waste products has been recognized in older agricultural countries for many years."

There is a possibility that the plants growing on peat deposits may become an asset. Dense and luxurious crops of grasses, sedges, and other fibrous vegetation characterize many thousands of acres of peat lands in Louisiana. Such fibrous material may become important in the manufacture of paper and possibly other products.

Peat Deposits in the United States

In the early part of the present century there was a period of interest in the peat deposits of the United States as a reserve source of fuel. The United States Geological Survey, anticipating a prospective shortage of coal and wood, made partial surveys of the peat deposits and estimated the available amount of peat, calculated on an air-dried basis, as 12,888,500,000 tons[3]. About that time there was marked development in the production of petroleum, and interest in peat as a reserve source of fuel abated.

During the period near the close of World War I there was marked interest in peat in this country and in Canada, as well as in the countries of the eastern hemisphere, mainly because of the seeming possibility of developing practical ways of making a distillate from peat that would serve as a substitute for gasoline for airplanes in the war. There was a shortage of gasoline for this use. The Congress of the United States appropriated $100,000 and stipulated "that the Secretary of the Interior is hereby authorized and directed to make experiments and investigations, through the Bureau of Mines, of lignite coals and peat, to determine the commercial and economic practicability of their utilization in producing fuel oil, gasoline substitutes, ammonia, tar, solid fuels, gas for power, and other purposes." However, this act was not approved until February 25, 1919, the war having closed while the measure was under consideration by the Congress.

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[2] Dachnowski-Stokes, A. P. Grades of peat and muck for soil improvement. U. S. Department of Agric. Circular 290. 1933.

[3] Davis, Charles A. United States Geological Survey, Bulletin 16. 1911.

The officials of the Bureau of Mines were of the opinion that the sum appropriated was inadequate for proper research on both lignite and peat. On that account, investigation was directed to lignite, as this seemed to be more promising of results, and work on peat was deferred. Later, with a residue of the appropriation, the Bureau of Mines conducted laboratory experiments on peat and attempted to evaluate the results which had been obtained with peat in Canada and other countries. In 1926 a bulletin[4] was published which included a review of the progress made in both hemispheres.

So far as the writer is aware there has been no further specific appropriation of Congress for research along the lines begun under the appropriation of 1919. Conditions may again develop that will make it desirable to consider the value of our peat as a source of heat and power. In the future preparations for emergencies, it may be important to know where our peat deposits are, what kinds of materials are in them, and all other information about them that may be desired.

When the possibilities of securing distillates for war were considered, the United States Geological Survey undertook a more complete investigation of the possible peat resources of the United States and made surveys of most of the known extensive deposits of this country. These surveys increased the estimated total available peat of the United States to 13,827,000,000 tons. At that time it was not known that there were extensive peat deposits in Louisiana and very little consideration was given to the probability of there being enough in this State to materially alter this estimate. In a bulletin[5] published by the Geological Survey the following explanatory statement appears: "Peat occurs in a narrow belt of land along the coast of Alabama, Mississippi, Louisiana, and Texas, but so far as the writers are aware the deposits have not been examined." As this bulletin is probably the most used reference in regard to the occurrence and use of peat in the United States, it is regrettable that more complete information about the deposits in Louisiana was not available to the authors. The amount of peat in Louisiana is so large that it merits appraisement and consideration when the peat resources of the United States are again investigated.

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[4] Odell, W. W., and O. P. Hood. Possibilities for the commercial utilization of peat. U. S. Department of Commerce, Bur. of Mines, Bulletin 253. 1926.

[5] Soper, E. K., and Osbon, C. C. The occurrence and uses of peat in the United States. U. S. Geological Survey, Department of Interior, Bulletin 728. 1922.

Recent Discoveries of Peat Deposits in Louisiana

Knowledge of the peat deposits in the southern portion of Louisiana has been greatly extended during the past 20 years. Dredging of commercial canals and drainage channels has uncovered peat deposits previously unknown. The discovery of rich petroleum reservoirs in many localities in the Gulf Coast territory of Louisiana has stimulated exploration of almost every nook of sea marsh in the State. Many localities were practically inaccessible until the development of "The Irrepressible Marsh Buggy," a motor-driven vehicle that combines some of the features of a farm tractor, a heavy duty motor truck, and a war tank. It has giant balloon rubber tires and is capable of riding down the dense vegetation that obstructs human penetration. It traverses soft terrain, crosses bodies of water on the buoyance of its tires, and travels at a rate of 8 to 12 miles per hour. While it was developed as a vehicle for traversing the marshes for oil explorations, its use has incidentally resulted in revealing the fact that in some portions of the territory whole groups of townships of land have a surface layer of peat. It would also be very valuable in locating the most favorable formations for development in case a market is found for Louisiana peat in commercial quantities.

SECTION II. PEAT DEPOSITS OF LOUISIANA

There are a number of districts in South Louisiana in which there are large areas covered with peat of some type. The information included in this bulletin in regard to these areas has been obtained by exploratory surveys and from men who have worked or lived in these areas. As these peat deposits form a resource in the State which has hardly been touched, it is hoped that some means will be found to continue the studies.

Peat of the Pontchartrain District

East of the Mississippi River and just north of the latitude of New Orleans are three lakes that form the major portion of the southern limits of a natural basin receiving the run-off from an area of approximately 25,000 square miles of territory in southwest Mississippi and southeast Louisiana. Named from west to east, the direction of their drainage, they are Lake Maurepas, Lake Pontchartrain, and Lake Borgne. The last named pours its water through two outlets into Mississippi Sound and several bays that open into Chandeleur Sound. It is more than a hundred miles from the open waters of the Gulf of Mexico to the west shoreline. With the exception of the north side and a short distance on the southwest side of Lake Pontchartrain, where well drained lands form the lake shore, all of these lakes are bordered by formations of peat and muck. The width of the formations varies from a few hundred feet at the narrowest places, to fifteen miles at the widest portions. The depth of formation ranges from one foot to 12 or more. In general, the formations back of the shorelines of Lake Maurepas and the west half of Lake

Pontchartrain have been formed from woody vegetation, the peat having been derived primarily from cypress (*Taxodium distichum* Rich.), sweet gum (*Liquidambar styraciflua* L.), sour gum (*Nyssa uniflora* Walt.), and tupelo gum (*Nyssa aquatica* L.).

In the region bordering the east half of Lake Pontchartrain and encircling Lake Borgne the formations are fibrous peat derived from saw grass (*Cladium effusum* (Sw.) Torr.), cat-tail (*Typha latifolia* L.), bull-rush (*Scirpus,* several species), sedge (*Carex,* several species), marsh grass or oyster grass (*Spartina,* two or more species—not determined), beef tongue (*Sagittaria lancifolia* L. and *S. latifolia* Willd.), wampee or pickerel weed (*Pontederia cordata* L.), paille finne grass or maiden cane (*Panicum hemitomum* Schultes) spider lily (*Hymenocallis sp.*), cut grass (*Zizaniopsis miliacea* [Michx] D, and A.), reed grass (*Phragmites communis* Trin.), and less important grasses, sedges, and rushes not determined.

Detailed soil surveys have been made of a part of this territory by the Bureau of Soils, U. S. D. A., in cooperation with the Louisiana Agricultural Experiment Station. These include the surveys of Tangipahoa Parish, Livingston Parish, and the New Orleans area.

In the Tangipahoa Parish survey[6] the northwest shoreline of Lake Pontchartrain is included. The area of peat reported was 59,200 acres. Most of this was in swamp land and the following quotations include the greater part of the description, which was written from the standpoint of soil appraisement and not with the thought of estimating the potential value of the peat.

> "For a depth of 3 feet or more, the material comprising the swamp is simply a brown peaty mass of decayed vegetation containing many root fibers and having a putrid odor. In certain parts of the swamp, a light drab clay was found underlying the peat at a depth of from 7 to 9 feet, but it lies usually much deeper than this. Most beds of the peat are covered with some standing water at all seasons of the year, and it is so nearly at sea level that during periods when a southeast wind blows the water from Lake Pontchartrain backs up along the bayous and overflows the lowlands to a depth of 2 to 3 feet. They are at all times boggy, and in some places, impassable."

Later in the report the following statement occurs: "Agriculturally, the peat has little value. The unstable character of the soil and subsoil is so nearly pure organic matter that only special crops could be grown upon it."

A sample of fibrous peat from the Tangipahoa area was obtained by the writer east of the Illinois Central Railroad tracks, approximately midway between Manchac and the north margin of the peat area. The location was about equally distant from the mouth of the Natalbany River to the west, and the mouth of the Chappepeela Creek on the east, and probably represented an area with the minimum amount of mineral sedimentation. The forest growth at this locality was scattered and paille finne grass (*Panicum hemitomum*) and *Sagittaria* (*S. latifolia*) constituted the prevailing plants. This peat sample was analysed by A. P. Kerr, Chemist of the Louisiana Agricultural Experiment Station, with the following results:

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[6] Griffen, A. M., and Thomas A. Caine. Soil survey of Tangipahoa Parish, Louisiana. U. S. Department of Agriculture, Bureau of Soils. 1907.

Analysis of Paille Finne and Sagittaria Peat

Ash	4.90 per cent
Volatile matter	94.10 per cent
Nitrogen	2.07 per cent

The ash content of this peat demonstrated that no appreciable mineral matter had been brought by sediment-carrying waters. The results corresponded closely with analyses of other fibrous peats in which *Sagittaria* was abundant (see later page of this bulletin).

Specimens of paille finne grass and *Sagittaria latifolia* were also analysed for a comparison with the peat. The paille finne grass showed 5.50 per cent ash, this being slightly lower than most recorded analyses of this plant. The Sagittaria plants showed the following ash content: petioles, 9.60 per cent; blades, 11.60 per cent; roots, 8.60 per cent; underground stems, 8.80 per cent.

Woody peat, which also occurs in Tangipahoa Parish, is mainly from cypress and sweet gum. Removing it from among the trees and stumps would be attended with much difficulty.

From areas near Lake Pontchartrain where there are open spaces, machinery for obtaining peat could probably be operated satisfactorily.

Livingston Parish is situated west of and adjacent to the south half of Tangipahoa Parish and Lake Maurepas. In the Soil Report of this parish[7] prepared by the Bureau of Chemistry and Soils, much information is included in regard to the large peat areas of this parish. The acreage of the different peat types is as follows:

Maurepas peat	23,296 acres	5.7 per cent of parish
Maurepas peat—marsh phase	192 acres	.1 per cent of parish
Barbary muck	22,336 acres	5.4 per cent of parish

Quoting from the report: "Maurepas peat is a slushy finely-disintegrated peat containing very little mineral material. It contains many roots and much partly decayed woody material. The underlying material is grayish-brown silty muck with a high mineral content, extending to a depth of 48 or more inches, where it passes into dark-drab clay. Maurepas peat appears to be woody peat largely derived from cypress. Its soft slushy character makes it hard to walk over. Roots of tupelo gum trees and cypress knees extend over the shallow water, and many rotting fallen logs are scattered over the surface." The map shows this formation covering a belt along the shore line of Lake Maurepas ranging from about a mile to five miles in width, and in six widely-separated areas surrounded by other soil types further inland. Quoting further: "The marsh phase of Maurepas peat includes areas of peat covered with grass and sedges instead of trees, and also includes small spots of open water. The trees and muck of the peat apparently have been burned off these open marsh areas. Large numbers of muskrats are trapped each year on the open marsh." The map shows this area one and a half miles west and a half mile south of the mouth of the Amite River. Nothing further is said regarding the identity of the grasses and sedges.

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[7] Anderson, A. C., et al. Soil Survey of Livingston Parish, Louisiana. U. S. Department of Agriculture, Bureau of Chemistry and Soils. 1931.

The reference to the abundance of muskrats suggests that the flora was probably cat-tails (*Typha angustifolia* and *T. pratens*), various sedges, sawgrass (*Cladium effusum*), and other vegetation common in territory a little further south where trapping is an extensive industry. The correlation of certain types of peat formation and muskrat population is discussed elsewhere. However, the area of this variety of peat is so small and so inaccessible that its importance is insignificant under present conditions.

The peat formations at several places where the peat and muck were supposed to be differentiated were examined by the writer, but no conspicuous difference in the two formations could be detected, unless it was in depth. Otherwise the descriptions quoted have been verified in a half dozen places. The slushy peat material constituted about two-thirds of the entire mass of material. Should any economic use for this kind of peat be discovered, some of the formations indicated as muck could also be used where the profile is deep enough to justify mining it.

In 1904 the Bureau of Soils published the results of a detailed survey of what was designated as the New Orleans Area[8]. It covered only the territory in the vicinity of the city and was intended primarily for the benefit of truck gardeners who sold their products locally. The following excerpt is taken from that report: "Between the Mississippi River and Lake Pontchartrain are extensive areas where the dense growth of vegetation has decayed and accumulated on the surface of the Sharkey clay to a depth from one foot to more than three feet. This more or less decomposed mass is made up of the trunks and leaves of trees, but more largely of the rank weeds and grasses of the locality."

A short distance beyond the limits of this survey there is an area of deep peat, covered with vegetation that is practically free of trees at the present time, except for occasional willows that have developed since reclamation work disturbed the natural terrain and the normal flora on the south side of the lake.

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[8] Rice, Thomas D., and Lewis Griswold. Soil Survey of the New Orleans Area, Louisiana. U. S. Department of Agriculture, Bureau of Soils, 1904.

Deep peat was found in what was believed to be an obsolete river channel near the south margin of Lake Pontchartrain running west from West End as will be seen from the following excerpt taken from a letter from Mr. Allan T. Dusenbury, Consulting Engineer, New Orleans.

> "Again in 1927, I had occasion to construct 10 miles of levee along the shore of Lake Pontchartrain in Jefferson Parish extending westward from West End.
>
> "Soundings along the line of the contemplated levee disclosed peat varying in depth from 8′ to 18′ and in order to build a stable levee through this type of land a dredge boat canal was first excavated, the material from said canal being deposited on each side thereof, the space between being about 128′ in width. Hydraulic dredges were then utilized, taking sand and silt from the bed of Lake Pontchartrain about a half mile off shore and depositing it in the canal above referred to.
>
> "Throughout the 10 mile stretch where the levee was constructed as above outlined, there probably was at least a half mile where the peat formation was 18′ in depth and a levee under these conditions could hardly have been constructed other than by the hydraulic method."

The peat here, in the few areas examined, was of the fibrous sedge-reed type. In 1913, Mr. W. G. Taggart, now Director of the State Experiment Stations, made a soil analysis of a sample taken near Little Woods, about 8 miles northwest of West End, on the south shore of Lake Pontchartrain, with the following results:

Organic and volatile matter	94.61 per cent
Insoluble matter	3.72 per cent
Iron and aluminum oxide	.10 per cent
Calcium oxide	.22 per cent
Magnesium oxide	.30 per cent
Sulphur trioxide	.16 per cent
Phos. pentoxide	.14 per cent
Sodium oxide	.64 per cent
Potassium oxide	.25 per cent
Insoluble silicon	.13 per cent
Moisture	46.20 per cent
Nitrogen	1.92 per cent

In order to secure some indication of the amount of sediment that had been deposited in that portion of the marsh that first received the overflow water from Chef Menteur in times of heavy rains, a composite sample was secured from the formation at a distance of approximately 200 feet from the bank of the Chef. The surface there was covered with a rank growth of *Phragmites,* growing to a height of 12 to 15 feet. Living roots and underground stems of the vegetation were discarded. The analysis gave results as follows: volatile matter, 61.5 per cent; ash, 38.45 per cent; nitrogen, 0.57 per cent.

Detailed soil surveys are not available for peat areas in the Pontchartrain district other than those mentioned above. From available maps, and from exploratory trips into the marshes, the writer has estimated that the total peat average in marsh lands in the Pontchartrain area not included in the 82,688 acres reported by the Bureau of Soils will approximate 100 square miles. It seems very conservative to assume that within this area there are 25 square miles that would have a peat profile of 4 feet of workable commercial peat. This would all be in open prairie, or land free of forest growth. While it may not be possible to work the peat in the timbered areas at the present time, the timber of the swamps should offer no greater obstacle to the utilization of the peat in this region than do the forest covers of many peat formations in other regions that are included in making an estimate of the total peat resources of the nation.

Three areas were located in which the peat was 12 feet or more in depth. Their areas were not determined. One area was located a short distance southeast of Little Woods; one near the north end of the Watson Williams Bridge; and one that was not explored but is said to run nearly parallel to Chef Menteur on the north side. An attempt was made to estimate the amount of peat in these deposits. Measured blocks of sedge-reed peat from the prairie-marsh land of this region were weighed, dried, measured and weighed again. These data showed that the lateral shrinkage was 33 1/3 per cent and the vertical shrinkage 25 per cent, or that the total volume shrinkage was 66 2/3 per cent.

These figures were approximate averages of several samples. The weights of the dried samples indicated that the peat from one cubic foot in the marsh would dry out to a weight of 6 to 8 pounds, being lighter when it had a large per cent of Sagittaria material. Eight pounds per cubic foot would represent a probable yield of 174 tons of dried material for each foot of depth of the profile, or 696 tons per acre. If we discount that to 600 tons per acre it would require only 3,333 acres to yield 2,000,000 tons. Six pounds per cubic foot would represent a probable yield of 130 tons per acre for each foot of the profile, or 520 tons per acre on a 4 foot profile. Discount this to 500 tons per acre, and 4,000 acres should produce 2,000,000 tons.

Estimates on weights per cubic foot check reasonably well with weights given for various varieties of peat as tabulated by A. P. Dachnowski-Stokes[9]. If it be assumed that there are 25 square miles of peat, with an average depth of 4 feet, in the prairie marshes of the lands bordering Lake Pontchartrain and Lake Borgne, and such index figures be applied, it would appear that this part of Louisiana is capable of producing 9,600,000 tons of air-dried peat. This is by far the smallest of the several peat regions that lie along the Gulf Coast region of the State.

Lake Salvador Peat District

Lake Salvador is a freshwater lake that is approximately 6 to 8 miles wide and 18 to 20 miles long, situated a few miles southwest of New Orleans. The long axis is northeast-southwest. It receives all the drainage water that flows from the area north of it between the natural levee on the west side of the Mississippi River and the natural levee on the east side of Bayou Lafourche. The lake is bordered on the north, west, and south sides by peat formations that range from 5 to 7 feet in depth. An area of undetermined size on the central east side of the lake is 13 to 14 feet deep. Trappers familiar with the country have reported that the peat formation bordering the northwest shore extends northward 10 to 12 miles and available maps support these statements. West of the southwest end of the lake the peat area continues westward to within a mile or so of Bayou Lafourche, becoming gradually shallower. South of the lake the same general character of terrain extends about 30 miles (nearly to the Gulf of Mexico) with a width of about 12 miles. This is a general estimate made from maps and information gained from reliable people who have some personal knowledge of the country.

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[9] Dachnowski-Stokes, A. P. Grades of peat and muck for soil improvement. U.S.D.A. Circular 290. 1933.

The writer's personal knowledge of the profiles of the formations and the character of the peat in them is limited to that secured in making soil auger borings during three days spent along the shoreline of the lake and in traversing two of the artificial canals leading from Bayou Lafourche into the deeper central part of the peat deposits. The extreme southern portion of the peat area was casually examined at a number of places between lower Lafourche and Grand Isle. At each observation point selected borings were made at distances from the banks of canals to give fair samples of the undisturbed formation, and at a distance from the shoreline of the lake, to avoid drift material at the lake margin. While the actual survey is little more than the examination of very small areas here and there, these spots are probably representative of the general formations that cover something like 300 square miles. If we discount this two-thirds and assume that 100 square miles have peat formations averaging 4 feet in depth and that one acre foot is capable of producing 150 tons of air-dry peat, the total available dried peat would be 38,400,000 tons. Most of this would be from mixed sedges, reeds, and grasses.

As one rides in a small boat in the lake or along the bayous and canals, it is not possible to see what kind of vegetation is to be found a few yards away. One must penetrate the marsh and get away from the material excavated from the canals and away from the drift material of the lake shore. It seems fairly safe to assume that general conclusions may be drawn from the data secured, at least the information gained will be helpful in planning more complete investigation. These conclusions are that vast quantities of sedge reed peats, cat-tail peat, sawgrass peat, and some fairly pure Sagittaria peat are to be found in this region. The more southern portion of the formations may be influenced by salt water, and possibly peat from such areas would be unsuited for some purposes.

The following excerpts from a letter from Mr. Allen T. Dusenbury regarding his experiences in a reclamation project about six miles southeast of LaFitte probably gives a fair picture of what may be encountered in a number of other places in the same region.

> "During the past thirty years, as engineer, I have had charge of a large number of reclamation projects in the Parishes of Jefferson, St. Charles, Terrebonne, and Lafourche. In all of these projects levees had to be constructed through marsh lands where the peat or peaty muck ranged in depth from 2′ to as much as 18′ in depth. A fair average depth of peat might be considered 4′ but in most of the projects a portion of the levee system had to be constructed through areas where the peat formation was much greater.
>
> "In Jefferson Parish on a project known as Jefferson Drainage District No. 3, there were a number of areas where the peat was very deep and to construct some of the levees, dredge boats had to pass over the work as many as seven times before the specified elevation was attained.
>
> "In this district, also, when the field ditches were being excavated with a Buckeye Traction Ditcher, this machine, weighing about 25 tons, broke through the surface and buried itself about 14′, the peat at this point being probably over 14′ in depth. The area in which this ditcher sank was originally a small lake or lagoon which had filled up with decomposed vegetation, approximating the nature of true peat."

Complete chemical analyses of the peat in this area were not made. However, the rainfall that drains into this territory carries very little sediment as it does not run through territories where erosion occurs. Overflows from the banks of the Mississippi seem to have had little influence on the mineral content of the greater portion of the territory.

When one follows the excavated drainage and transportation channels between Lake Salvador and Bayou Lafourche, one finds several places where the spill banks have sloughed away, indicating that the dredged material included peat and that the excavated material was not sufficiently firm to stand up on the spill-bank. These old channels are generally from 4 to 8 feet deeper than the level of the mineral soil on their banks.

Lake Hatch and Lake de Cade Peat District

Terrebonne Parish no doubt has a very large peat area, though the writer has had little opportunity to study it. From information gained from trappers, game wardens, and engineers, extensive peat deposits were anticipated around Lake Hatch and Upper Lake de Cade, and north of Bayou de Cade. Starting from the end of the peninsula that projects into the marsh on Mandalay Plantation, the marsh was penetrated to an estimated distance of four or five miles. The peat near the margin was Phragmites, then paille finne,—almost a pure stand except for some areas of Sagittaria. At a distance of about two miles from shore the vegetation was so tall and dense that one could form no estimate of the kind of vegetation that might be found a short distance away. The volume of fibre that is produced annually on these peat lands is enormous. The plants observed were mainly *Spartina* and *Phragmites,* 10 to 15 feet in height. The peat was only about 3 feet deep, but increased in depth as the distance from shore increased. Finally an area of *Sagittaria* and some sedges and grasses was encountered. The depth of peat there was 4 feet or more.

Lake de Cade formation was examined on the shoreline at only one place, at which fibrous sedge reed peat was found. Other peat areas in Terrebonne Parish were not investigated.

Terrebonne Parish has a very valuable trapping industry, based mainly on the catch of muskrats. As noted elsewhere, the muskrat habitat in Louisiana is almost sure to be a peat formation. While not all peat areas are inhabited by muskrats, all good trapping land that the writer has known in this region is peat land.

White Lake—Grand Lake Peat District

White Lake and Grand Lake of southwest Louisiana are reputed to be surrounded by extensive areas of peat. The writer has had opportunity to examine only a small part of the margin of the general basin and a most interesting peat deposit designated by civil engineers as Latanier River. This peat deposit is the channel of an extinct or "drowned river" or bayou. Mr. F. E. Everett, Civil Engineer of the Southwest Land Company of Crowley, and of the Florence Land Company, Gueydan, has made a number of surveys that crossed this channel. He has estimated the length of the Latanier deposit as being approximately 20 miles. The central deep channel is flanked on both sides by peat 4 to 5 feet in depth. By the courtesy and assistance of Mr. A. L. Arpin of Gueydan, President of the Florence Land Company, and Mr. G. E. Welch, Manager of the Florence Club, who furnished the writer with a motor boat and guide, it was possible to make examinations at a depth of 19 feet in the Latanier deposit. It was the opinion of Mr. Welch that the deposit will average 21 feet in depth. No estimate could be made of the southern limits of the deposit, but it probably extends almost to the Gulf of Mexico. The following letter from Mr. Arpin is of interest.

"I have yours re. peat in the Florence District. The old Bayou is filled in to a depth of 30 ft. Years ago I had analyses made and found 3 per cent nitrogen on top and 5 per cent or better deeper down. Don't recall how deep I went . . . This stuff is hardly old enough to be classed as peat but deeper down it may be OK for fertilizer."

This formation, near the protection levee of the Florence Land Company, is mainly covered at the present time with paille finne grass and some *Sagittaria,* but the peat at this locality is probably 50 per cent Sagittaria. Samples were taken somewhat further west, where the depth was 19 feet, and submitted to Mr. Kerr for analysis.

A composite of numerous soil auger samples from 8 to 12 inches of the profile showed:

Ash	9.65 per cent
Volatile matter	90.35 per cent
Nitrogen	2.37 per cent

A sample taken at 19 feet showed:

Ash	11.30 per cent
Volatile matter	88.70 per cent
Nitrogen	1.90 per cent

The width of this basin was not determined at a sufficient number of places to give a proper index of its average area. At 4 miles west of Florence Club House it seemed to be 1000 or more feet wide. Only one day was available for examining this formation. It is highly probable that this formation, exclusive of the broad peat beds on both sides, should be capable of producing 3 to 5 million tons of air-dried peat.

Woody Peat of Washington Parish

Washington Parish occupies the extreme northeastern corner of the pine hill section of the Florida parishes. The Bogue Chitto River runs through the parish. It is a stream with a swift current and has evidently shifted its course at some places, abandoning segments of the former channel. Some of these areas have become filled with peat. Pearl River, a somewhat larger stream, which is the boundary between Louisiana and Mississippi, has also shifted portions of its stream bed, and peat and muck now fill some of the abandoned segments.

The Bureau of Soils of the U. S. Department of Agriculture made a detailed survey of this parish in 1922 and published the report in 1928.[10] In the table giving the areas of the different soil types, the total area of muck is stated to be 1,216 acres. Some of this muck is said to be underlaid with peat.

The formation that was selected by the writer for observation was located on the property of Mr. John Smith, 4 miles south of Franklinton. It was in the first bottom of Bogue Chitto River, and Mr. Smith said that it included 40 acres. The formation was muck at the margin, but at a short distance from the margin it was made up of undecomposed leaves, twigs, roots, and logs. Probably 30 to 50 per cent of the existing forest vegetation was slash pine and black gum. The dominant growth was shrubs, belonging to the family *Ericaceae,* or Heath family.

The peat had probably been modified to some extent by the leaves of pines, oaks, hickory, and other trees which had been washed down from the steep hillside west of the formation. The peat was black and odorless. The maximum depth of the formation was about 12 feet. In times of extreme flood of Bogue Chitto River the formation flooded, but the deposits of sediment were not heavy. A composite sample of peat from the best part of the formation showed 25% ash. This variety of peat could probably only be harvested at a cost greater than its market value. People living near it could probably afford to secure it for special uses, but there is no reason to believe it will have a commercial value.

Other Peat Areas

There are other peat areas in the State which are as yet little known. It may be recorded, however, that peat deposits are found north of the cheniers—long narrow strips of drained lands—that border the Gulf of

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[10] Anderson, A. C., et al. Soil Survey of Washington Parish, Louisiana. U. S. Department of Agriculture, Bureau of Chemistry and Soils. 1928.

Mexico in Cameron Parish. The writer traversed as much of this territory as could be reached by automobile road, making occasional trips northward on foot to the margin of the marsh land. In every such instance peat was found.

The peat deposits of Iberia and St. Martin are discussed in Section III.

SECTION III. THE SAGITTARIA PEAT OF THE GRAND MARAIS AND LAKE TASSE AREAS

In Iberia and St. Martin parishes there are two very interesting and important peat areas. One is the long and narrow area near New Iberia and Jeanerette known as the Grand Marais and the other is Lake Tasse, with the territory surrounding it.

The peat in these areas is of interest because it is decidedly dominated by the tissues and residues of plants that exhibit the characteristics of the genus *Sagittaria*. Plants of this genus are reported as appearing in the peat formations of Florida, and along the Atlantic coast as far north as Maine, but so far as the writer has learned, they have not previously been accredited as being a dominant in peat formation. This peat, therefore, apparently represents a new variety and is being given the name of the genus of plants that gives rise to it, Sagittaria peat.

Unusual Features of the Grand Marais Peat Formation

According to geologists[11] the Grand Marais is a bit of territory which once belonged to the alluvial plain of the Atchafalaya river. Gradually in this area a sediment bearing stream, which is now known as Bayou Teche, built up the natural levees which now confine it. This stream left the escarpment that marks the west boundary of the Atchafalaya basin at a point near the present city of New Iberia and encountered it again at a point near the present city of Jeanerette, leaving a basin about 10 miles long and a mile wide, the west half of which became a fresh water lake. This is the region which is now known as the Grand Marais. This area at present receives the run-off water of an area several times its size without any distinct drainage channel leading into it or out of it.

Gradually this fresh water lake became filled with Sagittaria peat and a bog was formed which ranged in depth from 1 to 6 feet. (Fig. 1)

Prior to the peat formation in the Grand Marais, a considerable portion of the land included in the basin was forested with cypress and gum trees. In some areas, stumps and logs now covered by peat are abundant and well-preserved. These have been exposed in drainage canals which have been dug. (Fig. 2)

Approximately at the middle period of peat formation in the Grand Marais, logs and combustible material on the southwest shore line were

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[11] Howe, Henry W., and Cyril K. Moresi. Geology of Iberia Parish, Louisiana. Louisiana Department of Conservation. Geological Bulletin 1. 1931.

Fig. 1. Collecting peat samples from the Grand Marais formation.

burned, leaving ash and burned soil clearly marking the outline of trees and stump patterns. These later became covered with a new layer of peat.

In the Grand Marais, there are 2 parallel strips of mineral soil running through the peat area, about 100 feet apart and rising to an elevation of 4 or 5 feet above the level of the peat, then receding and becoming submerged in it, having a total length of more than half a mile. The strips of mineral soil really form two narrow islands in the peat formation. It is possible that these are the remnants of the natural levees of a stream that preceded the formation of Bayou Teche.

One of the interesting things about the Grand Marais is that the peat shows a very distinct line of cleavage separating the profile into two strata. None of the fibers of one layer penetrates into the other layer. The cleavage line is not at the same level in all parts of the bog. It is wavy, indicating that the peat from the upper stratum had settled down into depressions in the lower stratum. Nothing like this has been found in any other peat deposit in the State. This condition has not been explained satisfactorily, although several theories have been advanced. It is evident, however, that the explanations must be based on variations in the water level in the bog.

Unusual Features of Lake Tasse or Spanish Lake

Lake Tasse, or Spanish Lake, is a lake or basin located in Iberia and St. Martin parishes about 1½ to 2 miles west of New Iberia and 6 to 7 miles from the Grand Marais. It lies between the west natural levee of

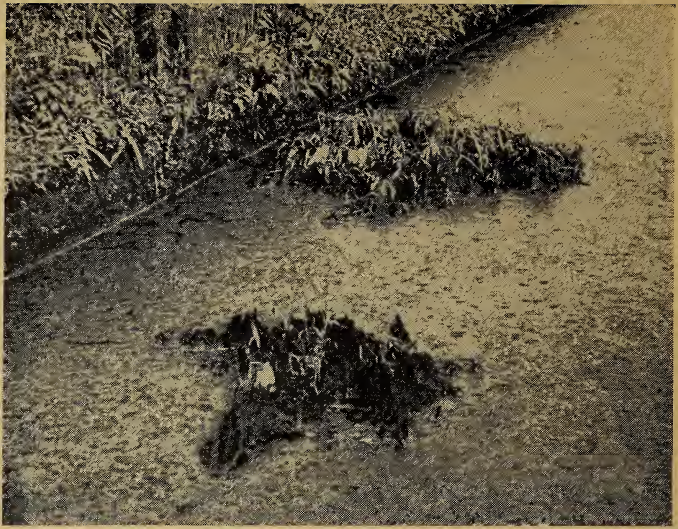

Fig. 2. Cypress stumps exposed in drainage canal in the Grand Marais.

Bayou Teche and the escarpment. It is quite similar to the terrain of Grand Marais except that there is an old channel opening into the basin that connects with the Vermilion river to the west and a semblance of a channel opening into Bayou Teche. There is a legend to the effect that at the time of the early settlement of the region by the French and Spanish, there was a direct water connection between Bayou Teche and Vermilion River through Lake Tasse. The Indians used this water course to travel by canoe from the Bayou Teche Valley to Lafayette.

At some time in the past, prior to written history, Lake Tasse covered about three times the area that it does at the present time. Vegetation encroached from the shoreline and gradually the more shallow portions became filled with peat. All of the old lake basin which is not now open water is covered with peat, most of which is of the Sagittaria type.

Also, a considerable portion of the bottom of the present lake is covered with a layer of peat. In general, this is approximately 2 to 2½ feet in thickness at the margin and gradually diminishes toward the central portion of the lake. It extends 200 to 300 yards on the south side, for a greater distance on the east side, and for an undetermined distance from the north shoreline. This formation has been covered by water as far back as can be determined by old maps. The maps of 1812, made from the first surveys and secured at the State Land Office at Baton Rouge, show the south shoreline of the lake coming entirely up to the escarpment.

An unusual feature of the basin is the presence of a double peninsula which extends from the old shoreline on the east side and gradually disappears in the peat toward the central portion of the ancient lake.

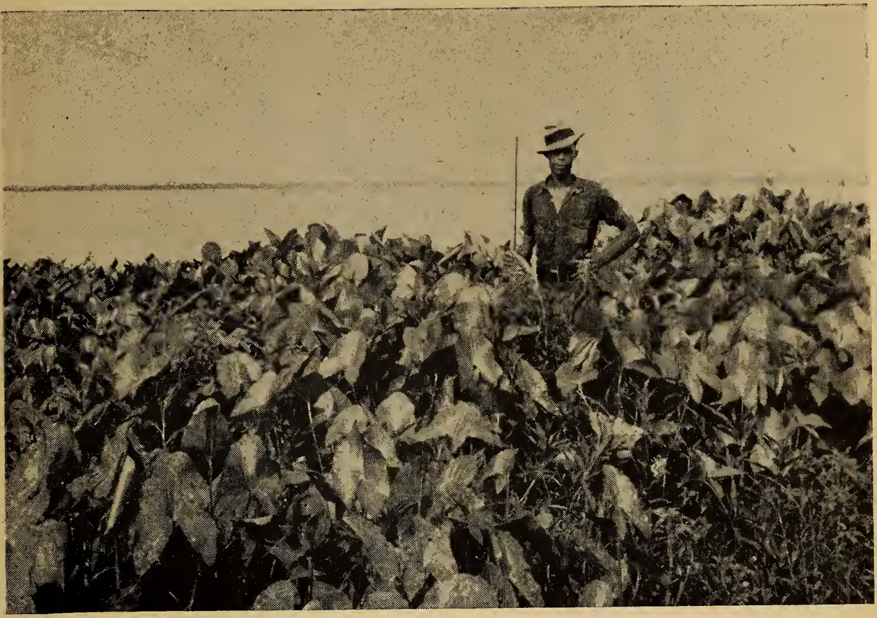

Fig. 3. Dense growth of *Sagittaria latifolia* on peat deposit on the shoreline of Lake Tasse.

When the bottom portion of the profile of the peat formation at the north border was studied, it was observed that the mineral soil at the bottom was penetrated by many roots which indicated that the parent plants grew where the residues are now. However, at approximately two-thirds of the distance from the north side of the formation to the edge of the water of the present lake it was found that there was a fairly well defined differentiation between peat and mineral soil, with very little indication that the roots of the growing plants reached the mud at the bottom of the lake. Apparently the plant growth extended from the margin toward the center of the lake until the water was too deep to permit the normal growth of *Sagittaria* plants with the roots anchored in the soil. A floating mass then developed on the border. This mat eventually submerged, forming a layer of peat on the lake bottom. The portion not submerged became the present peat area bordering the lake. At the shoreline at the present time areas with a dense growth of *Sagittaria latifolia* occur (Fig. 3).

Distinctive Anatomical Characteristics of Sagittaria Plants and of Peat Derived from Them

At present *Sagittaria latifolia* is the most prevalent species of the genus where changes of drainage conditions have not taken place. This species should probably be considered an annual, though new growth comes from

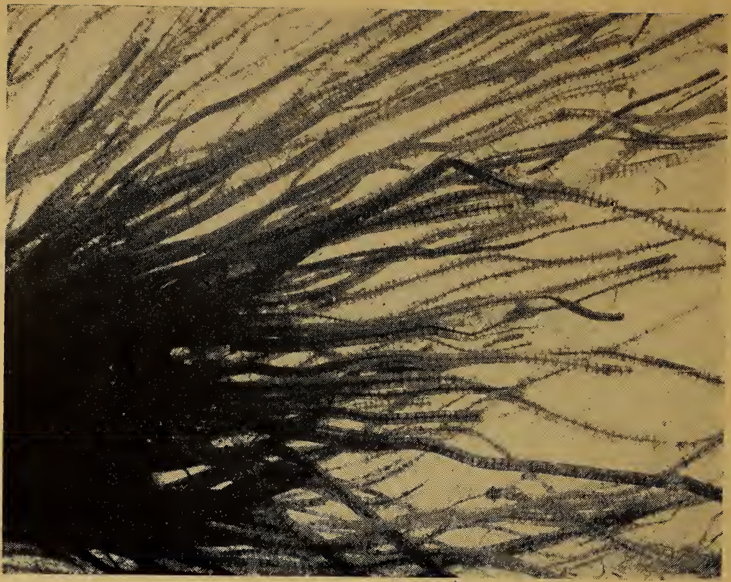

Fig. 4. Roots of *Sagittaria* showing the plate-like discs.

tubers. It may live through the winter if not frosted, but it is quite susceptible to frost and no specimens have been known to survive the winter at Spanish Lake, where the plant grows in abundance. Multiple primary roots are developed that grow to great length. Some may be found more than two feet below the surface. They do not branch, but many small fibrous roots come from the sides of the primary roots. The root consists of a central axis surrounded by plate-like structures extending to the epidermal layers which consist of two layers of thin-walled cells, generally rather transparent. Sometimes the plate-like structures are in the form of discs and sometimes they occur as spirals. Since the roots are generally about one-sixteenth of an inch in diameter, one can observe the general form of construction without the aid of a microscope (Figs. 4, 5). The discs or spiral turns are spaced at intervals about equal to the diameter of the root. The structure of the discs cannot be seen without the aid of a microscope. Their appearance is not easily described briefly, but may be shown in a reproduction of a photomicrograph. (Figs. 6, 7). The large basic cells are unusual. Extensions of the cell wall are formed like tubes. Each tube grows until it makes contact with a similar extension of the next neighboring cell. This creates a great number of intercellular spaces of irregular appearance. The spaces between the plate-like structures are filled with large, long, thin-walled cells that sometimes extend the full distance from one disc or spiral to the next one above it.

The peculiar cells in the plate-like structures in the cortex of the root are very characteristic of the genus *Sagittaria*. In studying peat, it is possible to identify *Sagittaria* by the presence of these cells. It is interesting to observe that Sachs, in his Textbook of Botany, published in 1882, illustrated these cells.

Analyses of Sagittaria latifolia

On account of the apparently large quantity of plant material on peat areas covered with *Sagittaria latifolia,* it seemed desirable to make a few analyses of this plant.

On June 8, 1937, single plants of *Sagittaria latifolia* were separated as to petioles, blades, and underground stems. Each lot was weighed, dried in an oven at 96 to 98° C., and reweighed. The following results were obtained:

Plant No. 1 *young*	*Gms. Fresh*	*Gms. Dry*	*Dry matter*
Petiole	67.37	4.85	7.2 per cent
Blade	25.70	1.63	6.3 per cent
Roots	23.20	1.80	7.7 per cent
Underground stems	14.24	.72	5.06 per cent
Plant No. 2 *old*			
Petiole	67.77	4.85	7.20 per cent
Blade	26.30	2.57	9.8 per cent
Roots	23.20	1.80	7.7 per cent
Underground stems	14.24 (?)	.72	5.06 per cent

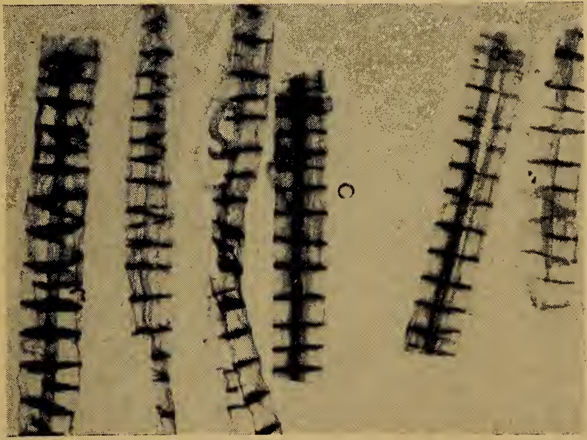

Fig. 5. Fibers of peat from the Grand Marais, showing the plate-like discs and spirals characteristic of *Sagittaria.*

On June 16, 1937, one square yard in a peat area was marked off and all living vegetation including the roots to a depth of 20 inches was removed. The material thus obtained was practically 100 per cent *Sagittaria latifolia.* This material was weighed, dried, and then reweighed with the following results:

Total weight before drying	2707 grams
Total weight after drying	250 grams
Dry matter	9.23 per cent
Total dry matter per acre	2500 pounds

A single plant of average size was carefully separated and the parts weighed, with the following results:

Petioles	170 grams	Underground stems	.87 gram
Blades	60.2 grams	Roots	52.00 grams

A feedstuff analysis of air dried material of the different parts of the plants was made by Mr. A. P. Kerr, with the following results:

	Crude Protein	*Fat*	*Nitrogen-free Extract*	*Fibre*	*Water*	*Ash*
Blades	22.50	4.80	35.10	17.80	8.20	11.60
Petioles	15.00	3.50	36.30	28.90	6.70	9.60
Roots	9.75	1.40	29.65	41.60	9.00	8.60
Underground stems	14.38	4.80	32.82	29.40	9.80	8.80

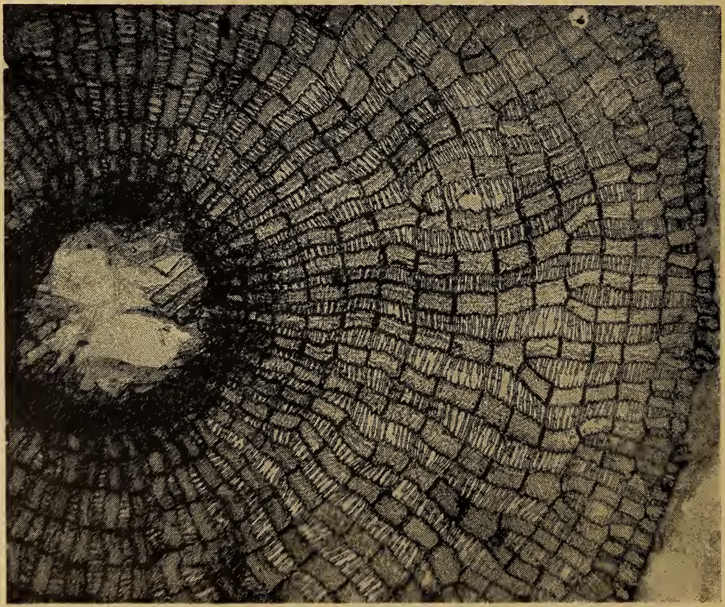

Fig. 6. A plate-like disc from root of *Sagittaria.*

Analyses of Sagittaria Peat

A few analyses were also made of samples of Sagittaria peat collected in the Grand Marais. The hydrogen-ion concentration averaged about pH 4.0.

The following chemical analyses were made by Mr. A. P. Kerr:

Per cent of volatile matter and ash in Grand Marais Peat

Depth	*Profile 1* *Volatile matter*	*Ash*
4 inches	96.21	3.71
10 inches	95.69	4.37
16 inches	91.37	8.63
22 inches	24.68	75.32
	Profile 5	
4 inches	91.91	8.09
10 inches	93.86	6.14
16 inches	96.06	3.92
22 inches	69.05	30.95
31 inches	80.80	19.20

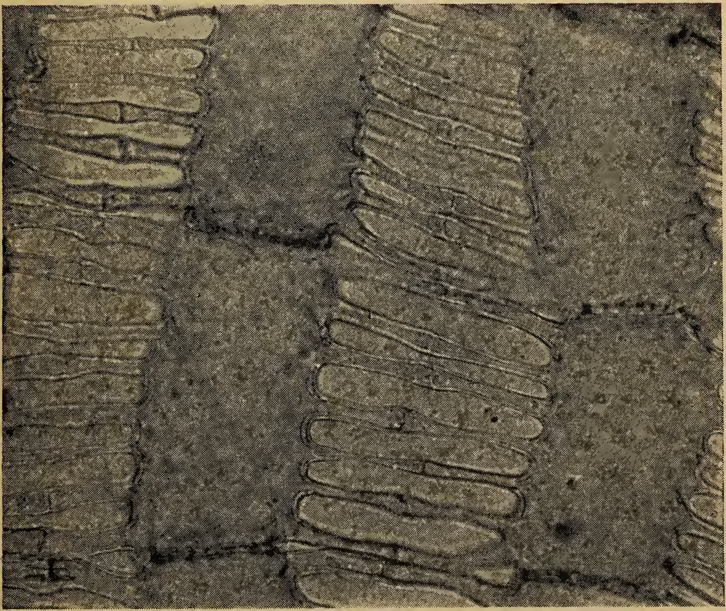

Fig. 7. Enlarged view of portion of disc-like structure in root of *Sagittaria* showing the peculiar characteristic cells.

Agricultural Analyses

Sample depth	*Nitrogen*	*Percentage* *Phos. Acid*	*Potash*	*pH*
4 inches	2.07	.12	.08	4
12 inches	2.74	.10	.08	4
18 inches	2.20	.09	.07	4.60
30 inches	.70	.08	.06	5.30

The acidity of the Grand Marais peat is about what is recommended for azaleas and camellias. While the profile is rather shallow, this should not prevent working the formation to a depth of about two feet if there is demand for the peat.

Shrinkage of Sagittaria Peat Upon Drying

A number of tests were made on the shrinkage of Sagittaria peat when taken from the marsh and air dried. The general conclusion reached was that the peat from Spanish Lake formation, where the land has not been pastured, shrinks 1/4 in vertical dimension and 1/3 in lateral dimension so that a cubic foot extracted in saturated condition would shrink on drying to 9 inches in vertical dimension and 8 inches in the lateral dimension or an actual shrinkage of 2/3 of the volume.

As a result of tests made on a number of blocks of peat measuring 2x3x3 inches, it was determined that a cubic foot of peat in the bog saturated with water would weigh about 70 pounds. Upon drying to the air-dried condition this weight decreases to about 8 to 10 pounds. This would represent a possible production per foot of depth of 174-217 tons of air-dried peat.

It was also determined that Sagittaria peat, when dried beyond a certain point, would not again absorb sufficient water to bring it back to the original weight.

In April, 1938, 5 cubes of peat from Spanish Lake taken near the bottom of a profile of a good peat section were cut and trimmed to a weight of 50 grams each. These samples were placed in the attic of the South Agricultural Building on the Louisiana State University campus and allowed to dry for a year, when they were again weighed. These samples were then immersed in water to test the capacity of reabsorption. The following results were obtained:

	Dried weight grams	*Weight after resaturation grams*
No. 1	4.85	18.70
No. 2	4.65	17.50
No. 3	4.87	18.30
No. 4	4.65	15.00
No. 5	4.86	20.20
Average	4.77	17.94

In another test a sample of 1000 grams of mixed Sagittaria peat from Spanish Lake and Grand Marais was dried to a weight of 300 grams. When resaturated the material again weighed 1000 grams. A similar sample reduced to a dry weight of 250 grams weighed only 600 grams when immersed in water. This showed that at some point between 30 per cent moisture and 25 per cent moisture there was a marked change in the absorptive capacity of the peat.

Samples from Grand Marais and Spanish Lake, when heated to 96° C.-98° C. would no longer regain their spongy texture and former weight when immersed in water for a prolonged period.

SUMMARY

1. Large amounts of peat are used annually in the United States for various purposes. Formerly a rather considerable percentage of this material was imported from Europe. At the present time, on account of war conditions, importations of peat have been practically eliminated.

2. Peat from the United States which is used in agriculture and in industry comes largely from peatmoss bogs located in the northern states.

3. That there are considerable areas of peat in Louisiana has been known for some time, yet there have been but few attempts to determine the extent of the peat deposits or the nature and the possible uses for the peat.

4. It has been possible in recent years to make some surveys over the peat areas of South Louisiana and to study in some detail one of the more interesting deposits.

5. Very large peat deposits were found in the vicinity of the various lakes, including Lake Pontchartrain, Lake Salvador, Lake Hatch, White Lake, Grand Lake, and Lake Tasse. The combined area of these deposits is several hundred square miles.

6. The peat in these areas consists of partly disintegrated parts of various plants such as reeds, grasses, sedges, woody plants, and various other aquatic plants. Sphagnum moss, which is common in many northern peat bogs, is not a common constituent of Louisiana peat deposits.

7. An interesting type of peat which apparently has not previously been described is given the name of Sagittaria peat. In this the dominant material consists of partially disintegrated roots of plants of the genus *Sagittaria.*

8. Large areas of Sagittaria peat occur in the Grand Marais and in the vicinity of Lake Tasse. The unusual features of the Sagittaria peat deposits are described in some detail.

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LOUISIANA BULLETIN 344 JUNE, 1942

HOW METHODS AND PROMPTNESS OF COOLING AFFECTS THE QUALITY OF MILK

With Suggestions for Producing High Quality Milk

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By

A. J. GELPI
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How Methods and Promptness of Cooling Affects the Quality of Milk

With

Suggestions for Producing High Quality Milk

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Milk is the number one item listed on the "Food for Freedom" program. Not only is there a need for more milk, but all milk produced must be of high quality. This emphasis on quality as well as on quantity is vitally important whether a nation is at war or at peace.

Quality in milk may be regarded from three important angles, namely; public health, keeping quality, and consumption of milk and milk products. Operators must keep in line with consumer demand and handle not only "safe milk," but also milk of high palatability and good keeping qualities. Low consumption of milk and milk products in the south as a whole may well be attributed in part to low quality.

Many of the off flavors so commonly found in milk, and particularly in manufactured milk products, are too often the result of microbial decomposition, and in this respect, proper cooling is frequently one of the important operations of production neglected by producers. It has often been found that either lack of cooling or improper cooling is the greatest cause of high bacterial counts in milk as it it received at the average milk plant. This means inferior milk, for quality drops rapidly as the bacterial count increases.

With the above facts in mind a study was undertaken to compare several of the methods of cooling milk that are commonly employed on farms in Louisiana. The methods of cooling studied included the following:

1. Cans of warm milk placed directly in a cooling tank without being previously chilled.
2. Milk cooled on a farm-type conical cooler with ice water as the cooling medium.

3. Milk cooled over a surface tubular cooler, with cold water from a mechanically refrigerated holding tank used as the cooling medium.

The milk in numbers 2 and 3 was held in a cold water tank following exposure to the surface coolers.

EXPERIMENTAL PROCEDURE

The milk used in this experiment was produced at the three University dairy farm units. One of the units, a milking parlor, used combine milking equipment; one unit used an ordinary milking machine; and the third used hand milking.

The following experimental plan, which employs what agronomists call the "split-plot" design, was used for the experiment: At monthly intervals three 16-gallon samples of milk were taken from each of the dairy units. One 16-gallon sample was cooled 15 minutes after time produced, another after 60 minutes, and a third, 120 minutes after being produced. Each 16-gallon sample was divided into three portions prior to cooling. Ten gallons were cooled in a 10-gallon can by being placed directly into a mechanically cooled and agitated holding tank. This tank contained water ranging in temperature from 33° to 40° F, and usually had an ice bank surrounding the refrigerating pipes on the walls of its interior. Three gallons each were cooled over the conical and tubular coolers, after which the milk was stored in separate containers in the same cooling tank that the ten-gallon can was placed in. The iced water in the conical cooler was agitated throughout the cooling periods. The equipment used included a medium-sized farm conical cooler in which ice water tempered to the desired temperature was used; a mechanically refrigerated holding box equipped with a small tubular surface cooler and water circulating pump. The water in the holding box was used both for cooling on the surface cooler and for holding all samples after cooling.

After a twelve-hour holding period, samples from each lot were taken for bacterial analysis, acidity test, methylene blue reduction test, and flavor score. Preliminary bacterial counts were made on milk from each unit on the days preceding each run. All bacterial counts were made according to the new standard methods, and were averaged by the use of logarithms. The reduction tests were carried through a period of eight hours, and the flavor scoring was based on recommendations given in U.S.D.A. Circular No. 384.

The monthly milk room temperatures of the three units and the average temperature of milk before cooling are shown in Table I. Monthly average temperatures of the milk varied from a low of 85.2° F in November to a high of 92.3° F in August, or a range of only 7.1°. As contrasted to this the temperature averages for the milk rooms at the time of milking varied from a low of 62.0° in November to a high of 82.6° for both August and September. While the high and low months correspond to those for temperature of the milk the actual range of 20.6° is approximately three times that of the milk. This shows that atmospheric temperatures do influence the temperature of milk but that the influence during a period of two hours or less is rather small.

TABLE I. Monthly Temperatures of Milk Rooms and of Milk Before Cooled

Month	Temp. of Milk Rooms		Month	Temp. of Milk Before Cooling	
	Range of Three Dairies*	Average		Range of Three Dairies*	Average
February (1940)	54°-74° F	65.3 F	February (1940)	81°-88° F	84.6 F
March	54 -78	70.6	March	84 -91	87.3
April	71 -79	75.2	April	86 -92	89.6
May	75 -80	76.6	May	90 -94	91.6
June	74 -82	76.6	June	88 -92	90.1
July	78 -86	82.6	July	88 -95	92.1
August	75 -90	82.6	August	88 -96	92.3
September	74 -82	82.6	September	86 -95	90.6
October	66 -80	74.5	October	88 -92	90.8
November	58 -69	62.0	November	81 -88	85.2
December	70 -77	72.6	December	81 -95	89.4
January (1941)	63 -65	64.1	January (1941)	82 -92	87.4

*Data secured by taking three readings from each dairy for each month.

RESULTS

The Effect of Type of Cooler and Holding Time (a. Bacterial Counts)

The relationship between the type of cooler used and the time held before cooling for the first phase of the experiment, in which all three dairy units were included for a 12-month period, are shown in Table II.

TABLE II. Relation of Type of Cooler and Time Held Before Cooling to Bacterial Count
(First Phase, Logarithmic Yearly Average for Three Dairy Units)

Type of cooler	Time Held Prior to Cooling			Average
	15 min.	60 min.	120 min.	
Can	21,900	20,000	26,600	22,800
Conical	12,900	13,800	13,100	13,300
Tubular	14,000	11,600	13,400	13,000
Average	15,800	14,900	16,700	15,800

Data in Table II show that can cooling caused increases in bacterial counts over that secured from tubular and conical cooling, and that holding milk up to 120 minutes prior to cooling only had a slight effect on bacterial counts.

It was thought that when excessively high counts were obtained that the effect of type of cooler and holding time might be more pronounced. The five high-count months were therefore sifted out and the logarithmic averages for these months are shown in Figure I. It will be noted that although the five high count months did not change the trend, more significant differences were found between the different types of coolers, and the counts showed a more pronounced increase as the holding time prior to cooling increased.

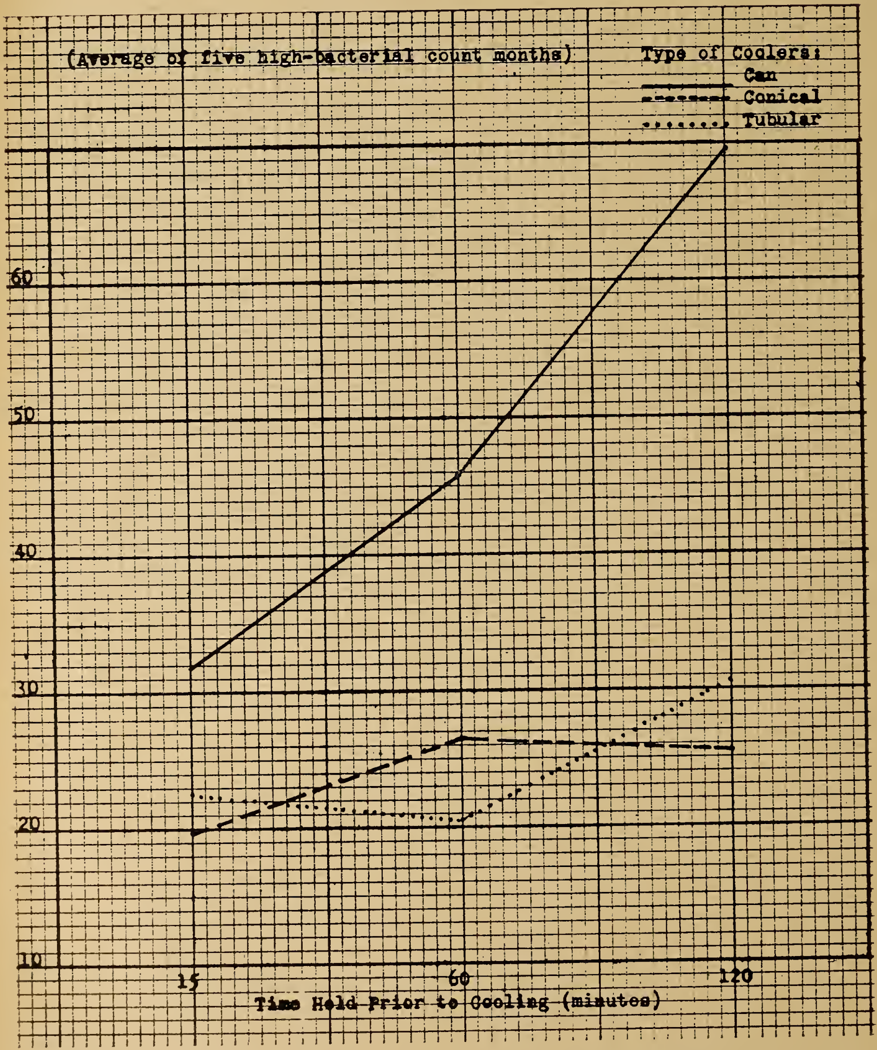

FIGURE 1. The Relationship Between Type of Cooler, Holding Time, and Bacterial Count

(b. Acidity and Flavor)

The effect of the method of cooling and the time the milk was held prior to cooling on the development of acidity, flavor and odor, and methylene blue reduction time is shown in Table III. As might be expected, milk cooled in cans showed slightly higher acidity than that cooled by other methods, and the fact that no increase occurred in those lots held for 60 and 120 minutes might be explained on the basis that the carbon dioxide content of the milk was probably reduced to some extent during the holding period.

TABLE III. The Effect of Type of Cooler Used and Time Milk Is Held Prior to Cooling to the Acidity, Flavor Score and Reduction Time in Milk
(First Phase, Yearly Average of Three Dairy Units)

ACIDITY

Type of cooler	15 min.	60 min.	120 min.	Average
Can	.182	.182	.180	.181
Conical	.181	.176	.176	.178
Tubular	.180	.178	.176	.178
Average	.181	.179	.177	.179

FLAVOR SCORE

Type of cooler	15 min.	60 min.	120 min.	Average
Can	19.8	20.0	19.6	19.8
Conical	20.1	20.1	19.7	20.0
Tubular	20.4	19.9	19.4	20.9
Average	20.1	20.0	19.6	20.2

Percentage of Samples Reducing Methylene Blue Within a Period of Eight Hours

Type of cooler	15 min.	60 min.	120 min.	Average
Can	25.0	31.2	34.4	30.2
Conical	21.9	18.8	25.0	21.9
Tubular	18.8	21.9	15.0	18.6
Average	21.9	24.0	24.8	23.6

The prevailing flavor and odor criticisms on all samples were cowy, feedy, weedy and barny, and the method of cooling or time of holding showed practically no effect from this particular standpoint. It is interesting to note that the milking parlor (one of the three units included in the experiment) which is at all times free from any barny, cowy, or feedy odors during milking, produced milk in which these flavors and odors were also pronounced. The average flavor score on the parlor samples was 19.7 and the scores for the other two units was 19.5 and 20.4 respectively. These results might well indicate that most of the cowy, barny, and certain feedy flavors and odors are taken into the cow's circulatory system by breathing and through the digestive system from feeds consumed prior to milking, rather than through absorption by the milk during the operation of milking. The fact that certain odors and flavors might be transmitted to milk through the cow's respiratory system has previously been pointed out by other workers in this field.* It is possible too, that such flavors and odors are not easily expelled when subjected to aeration.

(c. Reduction Test)

The results of the methylene blue reduction tests are in general agreement with the bacterial counts. These results, given as percentage of samples reducing within a period of eight hours, are shown in the bottom one-third of Table III. In comparing the three methods of cooling the reduction test was in close agreement with the respective bacterial counts. For example, during the twelve months the percentage of samples reducing methylene blue in eight hours was as follows: can cooling, 30.2%; conical cooling, 21.9%; and tubular cooling, 18.6%. The holding time prior to cooling also tended to increase the percentage of reductions, with 21.9% reducing from the 15-minute samples, 24.0% from the 60-minute group, and 24.8% from those held 120 minutes before cooling.

Relative Efficiency of Conical and Tubular Coolers

Results of this experiment (Tables II and III) have shown that under the procedure followed the quality of conical-cooled milk was as good as tubular-cooled milk. The dangers that lie in making a statement that this same equality will always hold true are numerous, but the most obvious one is the variations that can exist in the temperatures of the cooling media. For example, either a little or a great deal of ice may be used in the conical cooler and likewise the mechanically operated tubular cooler may have a faulty refrigerating mechanism.

The actual temperatures of the milk going over the two types of coolers as well as the temperature of the cooling media are shown in Table IV.

TABLE IV. Temperature Changes from Use of Conical and Tubular Cooler
(Average of 33 trials)

	Conical	Tubular
Average Temp. of Milk Before Cooled	89.3°F	89.3°F
Average Temp. of Cooling Water	32.6	36.3
Average Temp. of Milk Off From Cooler	42.2	41.7
Degrees Milk is Chilled	47.1	47.6
Difference Between Chilled Milk and Cooling Water	9.6	5.4

---

*Correspondence from W. E. Petersen, of the University of Minnesota and G. M. Trout, of Michigan State College.

It will be noted that the cooling water in the conical cooler (agitated by hand) averaged 32.6° F while that circulated through the tubular cooler averaged 36.3°, or 3.7° higher. The liberal use of ice in the conical cooler accounted for this difference. In spite of this advantage the milk after passing over the coolers averaged lower for the tubular (41.7°) than for the conical (42.2°). Likewise the tubular was more efficient, for milk thus cooled only lacked 5.4° of being as cold as the cooling medium while with the conical there was a 9.6° difference.

Variations in the amount of ice used in a conical cooler were tested in an effort to determine their effect on the cooler's efficiency and the milk's quality. The variations in amount of ice were arranged so that the temperature of the cooled milk would in one case be high (around 70° F), in another medium, (around 55°F), and in a third low, (around 40° F). The results of eleven trials (shown in Table V), gave a striking difference in bacterial count—50,500 for high temperature class, 33,300 for medium, and 31,600 for low. Estimates of ice necessary for the cooling of 100 pounds of milk for the temperature classes were 11.0 pounds for the high, 21.5 pounds for the medium, and 31.0 pounds for the low. These results clearly indicate that the use of a liberal amount of ice, plus frequent agitation, is necessary in a conical cooler if the cooled milk is to be comparable to that cooled over a good tubular cooler.

TABLE V. RESULTS OF COOLING MILK TO DIFFERENT TEMPERATURES WITH THE CONICAL COOLER

(Average of 11 trials)

	Temperature Class		
	High	Medium	Low
Pounds Ice Used to Cool 100# Milk*	11.0	21.5	31.0
Temp. of Cooling Water	66.5	53.6	37.0
Temp. of Milk Before Cooled	86.0	85.8	85.2
Temp. of Cooled Milk	68.7	55.6	43.8
Change in Temp. of Milk	17.3	30.2	41.4
Bacterial Count of Milk†	50,500	33,300	31,600

*Amounts of ice required were calculated from the known cooling capacity of ice and estimated losses.
†Milk was sampled for bacterial count after being held at approximately 45°F for 24 hours.

Inefficiency of Can Cooling

It has already been shown that can cooling of ten-gallon quantities of milk in a cooling tank was conducive to milk of lower quality than when milk was previously chilled over conical or tubular coolers (Tables II and III). Further evidence, of a more striking nature, was secured from one of the dairy units which used a cooling tank not carrying a sufficient ice bank to properly cool the cans of milk put into it. A check for 32 days revealed that milk left in this tank for the night and sampled the following morning, 14 hours after production, averaged 124,000 bacteria per cubic centimeter, as contrasted to a count of 15,800 for the morning's milk from the same dairy unit sampled three hours after production. (See Table VI.)

TABLE VI. THE EFFECT OF CAN-COOLING LARGE QUANTITIES OF MILK IN A MECHANICAL WATER COOLING TANK*

Number Trials	When Produced	Time Between Production and Sampling (hours)	Log. Average Bacterial Count
32	night	14	124,000
32	morning	3	15,800

*The cooling tank used did not carry a sufficient ice bank prior to using to prevent large quantities of milk from causing substantial increases in the temperature of the water within the tank.

These differences are much larger than would usually be the case where a cooling tank properly operated, was not overloaded.

OTHER ESSENTIALS IN THE PRODUCTION OF HIGH QUALITY MILK

Although the proper cooling of milk is very important from the standpoint of maintaining its quality, there are many other steps that must be taken in producing high quality milk. These are equally as important as is proper cooling. Properly cleaned and sterilized utensils; clean cows with properly washed and disinfected udders; clean surroundings, free from flies and fly breeding places; clean attendants, etc., are a few of the important phases of production which are frequently over-looked by some dairy farmers.

Clean Healthy Cows

Prior to each milking, cows should be first brushed off, with special care taken to clean the udders and flanks. Following this the udders should be wiped thoroughly using a clean rag dampened in a chlorine solution containing 100 parts per million of available chlorine. A good plan is to use the chlorine solution which was first used to rinse the utensils prior to milking. In muddy weather it is necessary that the udders, flanks and bellies of the cows be washed with water. A cow has been found to produce more milk if she is cleaned only a few minutes before she is milked rather than having a long time elapse such as would take place where the entire herd of 20 cows or more were cleaned before milking is started.

The necessity of having a disease-free herd can not be over emphasized. Such a herd not only prevents the possibility of transmitting a disease to humans, but also is on an average a higher producing and a more profitable one.

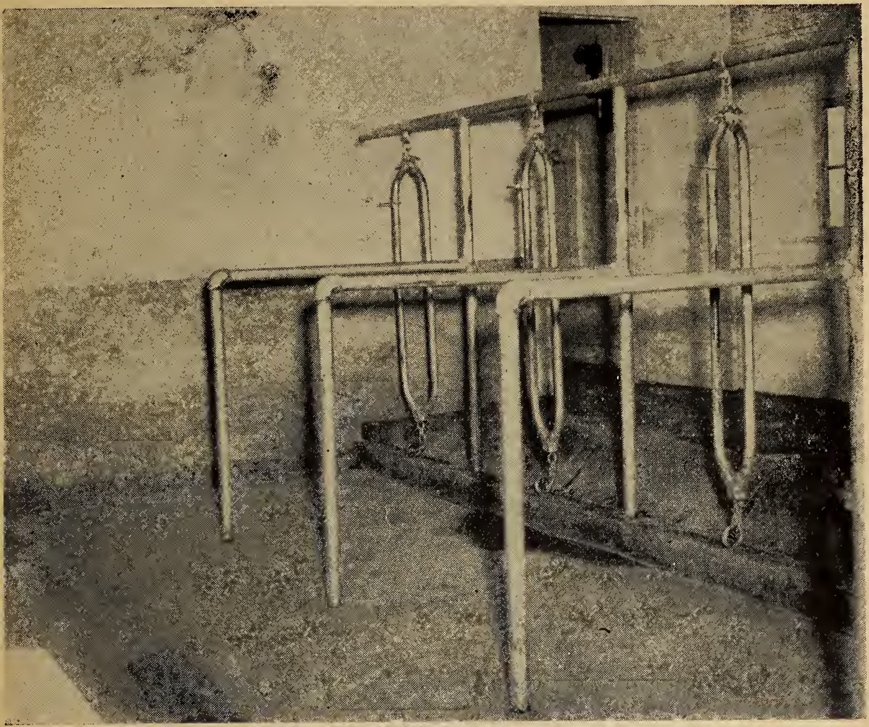

FIGURE 2. Clean Cows Need a Clean Barn. Note Concrete Floor and Painted Walls in Practical Milking Barn Shown Above

Cleansing the Utensils

Experimental results have repeatedly shown that the cleanliness of utensils exerts the greatest single influence on the bacterial count of fresh milk. Because of this the importance of the comparatively simple operation of cleansing and sterilizing milk equipment can not be over emphasized. To properly clean utensils they should first be rinsed with either cool or luke warm water to remove the adhering film of milk. This procedure aids in preventing the formation of "milk stone" on the surface of equipment. "Milk stone" is unsightly, insanitary, and is also difficult to remove once it is established. The rinsing should be followed by a thorough washing in a cleansing solution. The solution should consist of warm water and an alkali washing powder, but not soap or a soap powder. The utensils should be scrubbed in this solution using a good stiff brush but not a cloth. Next rinse in clear hot water, (180° F if possible) and then the utensils are ready for sterilization.

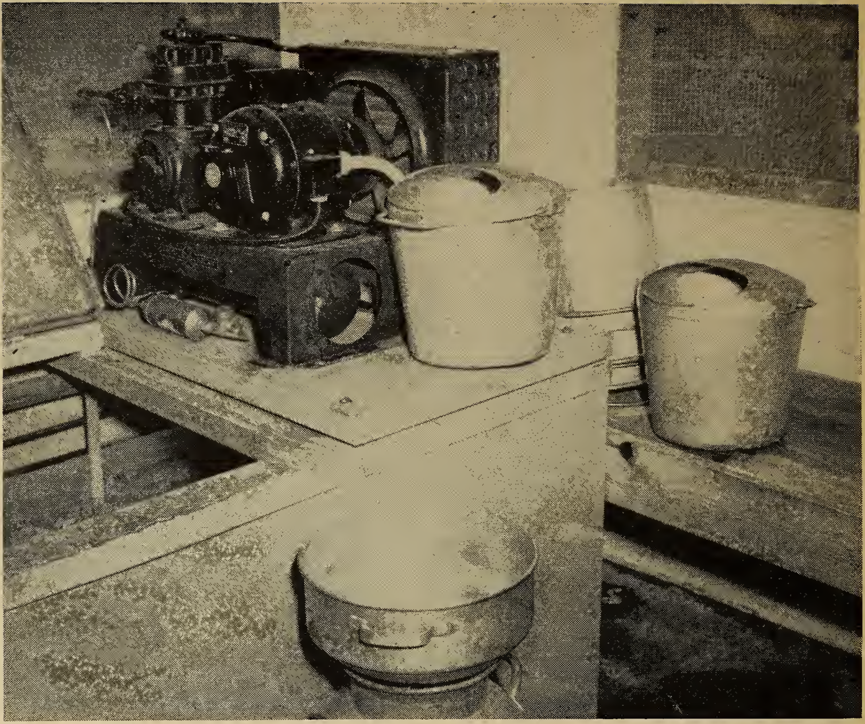

FIGURE 3. Some Essential Equipment for High Quality Milk—A Cooling Tank, Small-top Milk Pail, and a Filter-pad Strainer.

Sterilizing Utensils

Steam and chemical sterilization are the two methods most commonly used. Steam sterilization is better suited for large producers for it requires considerable equipment and a little more labor. Chemical sterilization is better suited for the small producer because it is more economical, and requires less time and labor. Either method is equally efficient when properly used. When using steam the utensils must be exposed to live steam at a boiler pressure of about 20 pounds for at least 15 minutes to insure good results. In chemical sterilization chlorinated solutions are most commonly used and recommended. Chlorinated solutions are usually made from calcium or sodium hypochlorites and may be easily prepared at home from ordinary chlorinated lime (laundry bleaching powder) or they may be purchased from most dairy supply houses.

To obtain best results with chlorinated solutions the utensils must first be thoroughly cleaned, that is, the surfaces must be free of all organic matter. Then the utensils should be immersed in the sterilizing solution containing at least 100 parts per million of available chlorine (made up according to directions when a commercial compound is used) for three to five minutes. Remove from solution and allow to drain, but do not rinse off the solution. Place the utensils on a clean table or shelf away from dust and flies, and rinse in another chlorinated solution before using for the next milking.

Use of Strip Cups and Cover-top Pail

The initial bacterial count of milk can be held down considerably by using the strip cup just prior to milking thus allowing the discarding of the first two or three streams of milk from each teat. The strip cup also helps detect any abnormal milk (such as results from mastitis or garget) from an udder which might otherwise go unnoticed.

Small-top milk pails are also helpful in producing high quality milk. Tests have shown a sharp reduction in both sediment and bacteria in milk produced after small-top pails are used. Most health rules governing the production of high quality milk require the use of this type of milking pail.

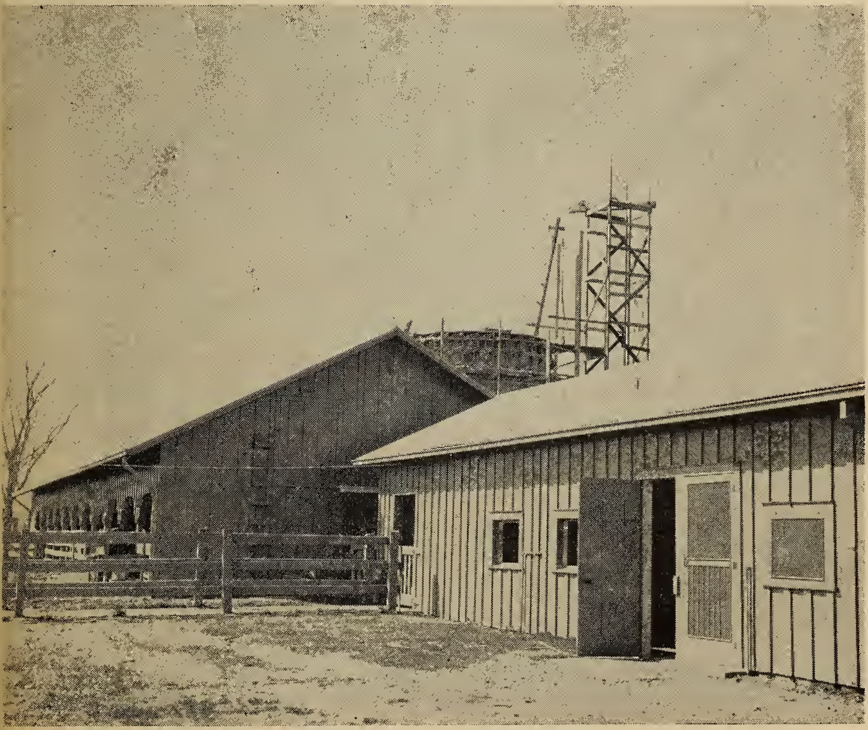

FIGURE 4. A Practical Dairy Barn Set-up. A Combination Milking Barn and Milk House in Foreground and a Loafing Shed and Silo Under Construction in Background.

Controlling Flies

The control of the house fly is a necessary step in the production of clean milk. Flies are not only troublesome to the milkers and the cows, but from its habits of living, it can serve as a transmitter of such intestinal diseases as typhoid, paratyphoid, dysentery, etc. directly to the milk supply. The house fly can best be combated by eliminating its breeding places. To do this the dry lots and feeding sheds should be kept clean and free from any decomposing manure, waste feed, silage, or hay. Damp, decaying silage should not be allowed to accumulate around the silos and the vicinity of water troughs and feed racks should be kept clean. Sprinkling powdered borax once or twice a week over the above mentioned places and also on compost heaps will effectively destroy any fly larvae and will help to a great extent in keeping down the fly crop.

SUMMARY OF COOLING EXPERIMENTS

1. The effect of methods of cooling on the quality of milk was studied with three commonly used procedures, namely: Cooling 10-gallon cans of milk in a motor-stirred water tank at temperatures ranging from 33 to 40° F; cooling on a surface tubular cooler to between 33 and 36° F, followed by holding in water at 33 to 40° F; and cooling on a conical cooler to 33 to 36° F and hold in water at 33 to 40° F. The period of holding before examination was approximately 12 hours.

2. It was found that milk cooled in the cans contained more bacteria than that chilled by the tubular or conical coolers. The counts (logarithmic averages) over a period of a year were 22,800, 13,300 and 13,000, respectively.

3. The effect of a delay in cooling was observed by holding portions of milk (16 gallons) for 15 minutes, one hour, and two hours before cooling. It was found that a delay of two hours did not materially affect the quality of milk when it was rapidly chilled over a tubular or a conical cooler and held at a temperature of 40° F or lower for 12 hours. A delay of two hours followed by cooling in the can to below 40° F resulted in a significant increase in bacterial count after holding for 12 hours.

4. The methods of cooling had apparently no detectable influence on the flavor.

5. Can-cooled milk reduced methylene blue within a period of eight hours more frequently than did milk cooled over conical and tubular coolers.

6. Tubular cooling proved to be more efficient than conical cooling, but excellent results were secured from conical cooling when liberal quantities of ice were used, and the cooling media was agitated.

7. Can cooling in an over-loaded cooling tank was the least effective cooling method studied.

SUMMARY OF PROCEDURE FOR PRODUCING HIGH QUALITY MILK

1. Maintain a disease-free herd.
2. Clean cows before each milking by brushing, washing, and wiping the udders with a cloth dampened in chlorine solution.
3. Maintain clean utensils by:
    (a) Rinsing immediately after use in either cool or lukewarm water.
    (b) Washing with a stiff brush in warm water containing an alkali washing powder.
    (c) Sterilizing in a steam cabinet or by use of a chlorine disinfectant.
    (d) Inverting on a rack to dry, protected from the dust, flies, and wind.
    (e) Rinsing in a chlorine solution just prior to milking.
4. Use a small-top pail for milking.
5. Use a strip-cup to reduce bacterial count and to detect abnormal milk.
6. Control flies by destroying their breeding places and by sprinkling borax over manure and other organic matter around the barn.
7. Cool milk by use of either a tubular or conical cooler and hold it below 40° F until it reaches the milk plant.

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Cotton Marketing Practices in Selected Local Markets in Louisiana

By

H. W. LITTLE AND ROY A. BALLINGER

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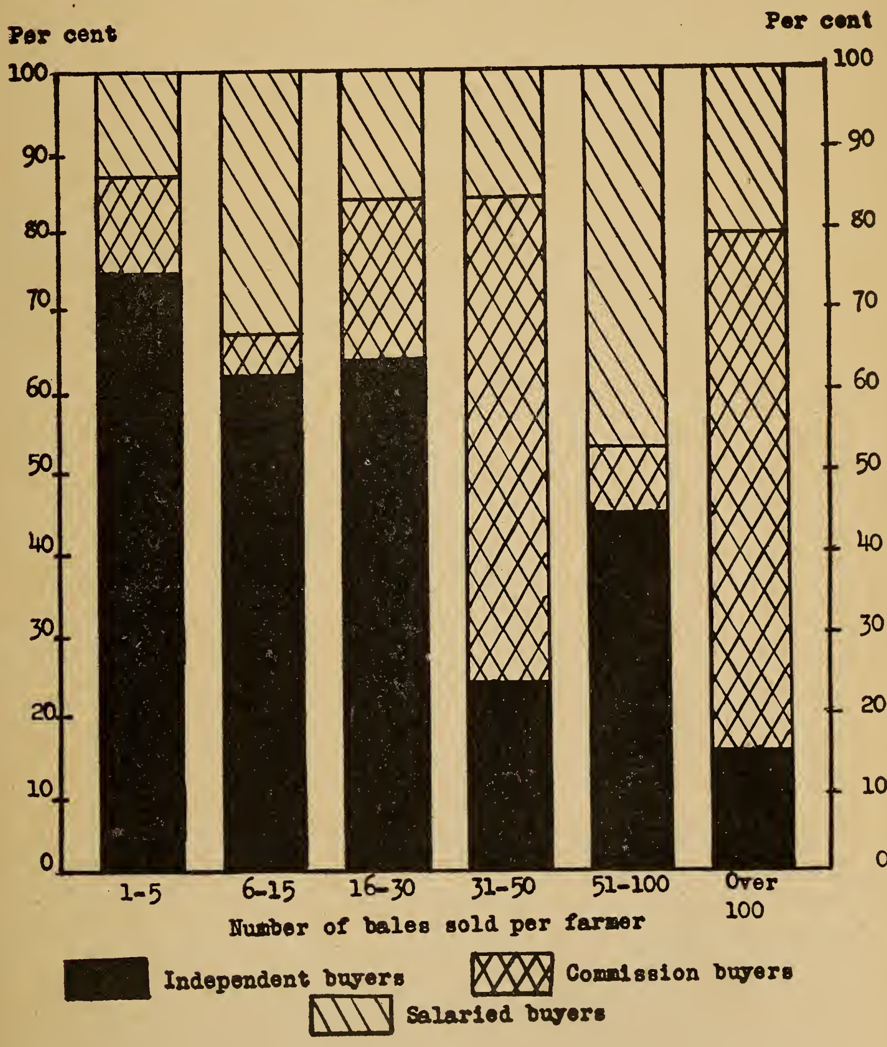

Distribution of cotton sales between types of buyers according to the number of bales sold by farmers

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AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS
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Cotton Marketing Practices in Selected Local Markets in Louisiana

By H. W. Little and Roy A. Ballinger[1]

INTRODUCTION

Cotton is the main source of cash income for a large majority of farmers in the northern half of Louisiana and in several sections of south Louisiana. Practices followed by buyers and sellers of cotton in the communities which are the growers' markets for this commodity, and conditions which exist in these markets vitally affect the welfare of the growers. The number and types of outlets available to the grower for his cotton, the extent of his knowledge of its quality and of existing market conditions, and many other factors affect his competitive position in the market. Recent government programs, such as the cotton loan program, and the free classing and market news service available to members of cotton improvement groups have materially changed some of the conditions existing in local markets.

In the present study information was collected by personal interview from 184 cotton growers and 52 cotton buyers in eight markets in north and central Louisiana (See figure). The information related to the 1940-41 cotton marketing season. Data for south Louisiana were not included because the cotton crop in that part of the state was unusually poor in 1940 and cotton is a major crop in only a few sections of the area. At least 20 growers, selected at random, were interviewed in each market. Information was obtained from practically all of the local buyers located in the markets studied.

The markets selected for study were all compress or warehouse points and not exclusively growers' markets since some of the buyers bought a small proportion of their volume from other buyers. However, it is the general practice of most growers in marketing their cotton to sell to buyers from these warehouse points, usually in the town itself, but sometimes at nearby country gins, stores or railroad platforms. In some cases growers sold directly to small country merchants or ginners located in the vicinity.

PRODUCTION OF COTTON

There was a wide variation between markets in the average amount of cotton produced per grower. The lowest average production per grower

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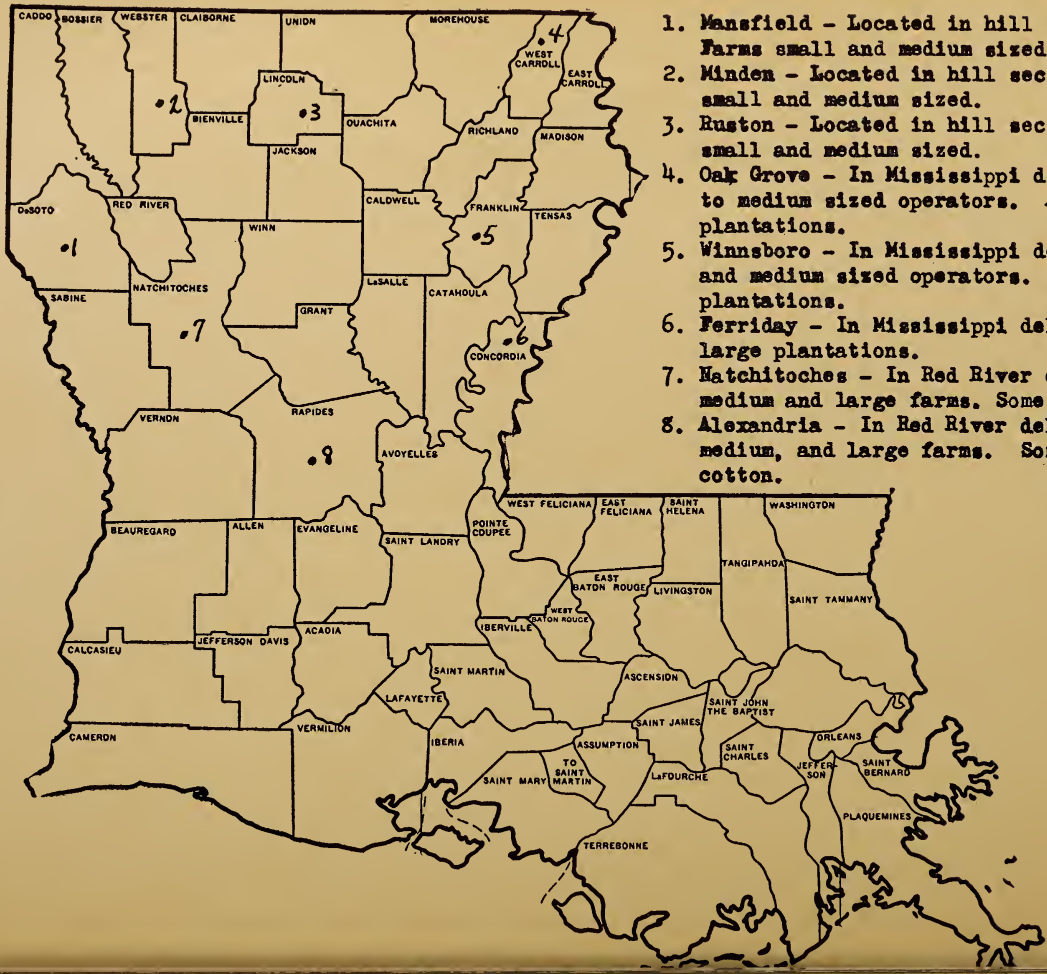
[1] Dr. John W. Wright and John G. Gibert of the Agricultural Marketing Service, United States Department of Agriculture assisted the authors in planning the study and in collecting and analyzing the data.

MARKETS INCLUDED IN STUDY



1. Mansfield - Located in hill section. Farms small and medium sized.
2. Minden - Located in hill section. Farms small and medium sized.
3. Ruston - Located in hill section. Farms small and medium sized.
4. Oak Grove - In Mississippi delta. Small to medium sized operators. A few large plantations.
5. Winnsboro - In Mississippi delta. Small and medium sized operators. A few large plantations.
6. Ferriday - In Mississippi delta. Mostly large plantations.
7. Natchitoches - In Red River delta. Small, medium and large farms. Some hill cotton.
8. Alexandria - In Red River delta. Small, medium, and large farms. Some hill cotton.

for those interviewed was found at Ruston and the highest at Natchitoches and Ferriday (Table 1). The former market is located in a hill section of the state while both of the latter are in plantation sections of the Red River and Mississippi River deltas.

In recent years there has been a decided shift towards the production of improved varieties of cotton in Louisiana. Growers in each community or area have been urged to grow only a single variety of cotton. A relatively few varieties now make up most of the cotton grown in Louisiana. Almost three-fourths of the cotton grown by the growers interviewed was of the Delta pine variety, about 14 per cent was Delfos, and 5 per cent Stoneville. In each of the individual markets except Alexandria, Delta pine was the most important variety. Nearly one-half of the cotton in Alexandria was Stoneville and 28 per cent was Delfos.

It is estimated that in 1940 there were approximately 125 one-variety cotton improvement groups in Louisiana. The proportion of the growers interviewed who were members of a one-variety group was highest at Minden where 48 per cent belonged and lowest at Alexandria where there were no members. In all the markets where the proportion of Delta pine cotton was 90 per cent or more the proportion of growers belonging to one-variety groups was greater than 20 per cent. In markets where the proportion of Delta pine cotton was small the number of growers belonging to one-variety groups was low.

Distance Hauled to Gin

The distance which a farmer hauls his seed cotton to have it ginned usually depends upon the distance of his farm from the nearest gin. However, it sometimes happens that a grower hauls a greater distance than that to the nearest gin. There are various reasons for this, such as variations in ginning services and charges, and the personal preference of farmers. Hauling to some gin other than the nearest one has become increasingly important with the development of the motor truck as a means of hauling.

For all producers in the eight markets, the average distance hauled was 4.6 miles (Table 2). Growers in the Natchitoches, Ferriday, and Minden markets hauled the shortest average distances.

In places the practice of hauling seed cotton to the gin by the ginners has developed either as a competitive measure or because growers lack the equipment for hauling. The practice seems not to have been followed to any significant extent in the markets studied except at Alexandria. The ginners there hauled approximately 27 per cent of growers' seed cotton. Six per cent was hauled by ginners at Ruston and five and four per cent respectively at Natchitoches and Ferriday.

TABLE 1. AVERAGE PRODUCTION OF COTTON PER GROWER, BY VARIETIES, AND PER CENT OF GROWERS BELONGING TO ONE-VARIETY GROUPS, 1940-41 SEASON.

Market	Number of growers	Average number bales produced per grower	PERCENTAGE DISTRIBUTION OF PRODUCTION BY VARIETIES						Per cent of growers belonging to a one-variety group
			Delta pine	Stone-ville	Delfos	Wilt resistant	Unknown	Other	
Mansfield	24	24.9	96.8	0.0	0.0	0.0	0.0	3.2	29.2
Minden	23	22.7	93.7	0.0	0.0	0.0	0.6	5.7	47.8
Ruston	26	8.9	93.9	0.0	0.0	6.1	0.0	0.0	23.1
Oak Grove	21	23.6	99.6	0.4	0.0	0.0	0.0	0.0	23.8
Winnsboro	23	16.2	98.1	1.9	0.0	0.0	0.0	0.0	21.7
Ferriday	22	65.3	46.5	0.2	41.7	0.0	5.9	5.7	13.6
Natchitoches	24	71.3	86.3	0.4	2.9	0.0	8.6	1.8	4.2
Alexandria	21	28.5	12.5	47.7	27.8	0.3	0.0	11.7	0.0
TOTAL	184	32.7	73.2	5.1	13.7	0.3	3.9	3.8	20.7

TABLE 2. AVERAGE NUMBER OF MILES FROM FARM TO GIN AND PER CENT OF COTTON HAULED BY GROWER AND BY GINNER, SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Average number of miles, farm to gin	Per cent of bales transported: By grower	By ginner
Mansfield	4.8	100.0	0.0
Minden	3.0	97.5	2.5
Ruston	5.1	93.9	6.1
Oak Grove	5.6	100.0	0.0
Winnsboro	5.5	100.0	0.0
Ferriday	3.4	95.8	4.2
Natchitoches	3.4	94.6	5.4
Alexandria	5.6	73.4	26.6
TOTAL	4.6	94.4	5.6

MARKET OUTLETS USED BY GROWERS

Government Loan: The government cotton loan program has created in recent years what amounts to an additional outlet through which farmers may dispose of their cotton. The placing of cotton in the government loan by a producer does not amount to an outright sale. For all practical purposes, however, the producer has completed the marketing of his cotton by putting it in the government loan except for the possibility of later selling his equities in the cotton at a profit if prices rise sufficiently. The loan program has improved the competitive position of the farmer in the local market through its effect on the local level of cotton prices and by partially forcing buyers to pay for cotton more nearly on a quality basis.

Loans to growers on their cotton through the Commodity Credit Corporation were an important method used by growers in marketing their cotton in all markets considered. Approximately 56 per cent of all the producers interviewed placed at least a part of their cotton in the loan. More than one-fourth of the growers placed all of their cotton in the loan.

Nearly 44 per cent of the farmers sold all their cotton outright. The number of bales belonging to these growers amounted to almost 63 per cent of the total, indicating that the larger producers were more inclined to sell outright than were the smaller ones. Those who sold part of their cotton and put part in the loan placed about two-thirds in the loan. The 28.6 per cent of the producers who put all their cotton into the loan handled only 20 per cent of the total volume of cotton represented. The proportion of cotton sold outright was greatest at Ferriday, Alexandria, Oak Grove, and Natchitoches, all of which are largely delta markets.

Types of buyers: From the standpoint of their relation to the grower, buyers may best be classified according to major types of activities. Buyers in Louisiana may be divided on this basis as follows: supply merchants, ginner buyers, local cotton merchants, and representatives of central market cotton merchants. Some buyers belong in more than one of these classes. For instance, a buyer may be both a supply merchant and a ginner.

Supply merchants sell fertilizer, seed, feed, groceries, and numerous other items to growers on credit. Growers usually pay for these advances upon the sale of their cotton. The producer may or may not be obligated to sell his cotton to the merchant but in many cases it is more or less automatically turned over to him on account. Plantation owners who have stores through which supplies are furnished to tenants on their place were not considered supply merchants in this study since the owners usually sell the tenants' cotton along with their own.

The proportion of cotton sold to supply merchants was relatively small, although this outlet was of importance to small growers. Supply merchants purchased only 2.7 per cent of the total amount handled by the local buyers interviewed (Table 3). The only markets where the purchases by this type of buyer constituted any significant part of the total were Ruston and Oak Grove. At Ruston approximately 10 per cent of the total purchases were made by merchants. At Oak Grove, the proportion was almost 7 per cent. At the remaining markets the proportion ranged from 3 per cent to zero.

Growers in south Louisiana are known to sell a large proportion of their cotton to ginners, but the volume sold to this type of buyer was comparatively small in the markets studied. However, the ginners in some cases were a rather important outlet for small growers. Indications are that sales were made to ginners in some cases largely as a matter of

TABLE 3. VOLUME AND PER CENT OF COTTON PURCHASED BY TYPES OF BUYERS IN SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Number of buyers	NUMBER OF BALES					
		Total	Supply merchant	Ginner buyer	Supply merchant ginner	Local cotton merchant	Representative of central market cotton firm
Mansfield..........	4	4,110	65	0	0	500	3,545
Minden............	7	10,900	200	0	400	5,200	5,100
Ruston.............	12	11,449	1,200	800	550	3,500	5,399
Oak Grove.........	4	6,553	454	0	0	6,099	0
Winnsboro..........	7	32,567	1,017	0	1,450	10,100	20,000
Ferriday...........	5	11,100	0	2,000	800	5,100	3,200
Natchitoches........	7	21,525	0	0	300	15,000	6,225
Alexandria..........	5	10,643	0	275	500	100	9,768
TOTAL....	51	108,847	2,936	3,075	4,000	45,599	52,237
Per cent...........		100.0	2.7	2.8	3.7	41.9	48.9

convenience, providing the ginner would purchase the cotton. It was usually ginners located in the territory surrounding the market center who bought cotton. The ginners located in the town seldom did so. The only markets among those studied at which ginners purchased cotton were Ferriday, Ruston, and Alexandria. The volume of purchases were relatively small except at Ferriday.

Supply merchant, ginner, and cotton buyer was a rather common combination of business activities, especially in small communities which were included as part of the markets studied. The volume of purchases by such buyers constituted a relatively small proportion of the total purchases in the markets considered but were somewhat larger than those by ginner-buyers who were not supply merchants and supply merchants who were not ginner-buyers.

Local cotton merchants purchase cotton as a major business enterprise and operate for their own account. Growers usually make their sales to such dealers in town but in some cases the buyer may purchase from growers at country gins, stores, or the grower's farm. They may purchase a portion of their cotton from supply merchants, ginner-buyers, or other local dealers but as a rule, most of it is obtained direct from growers.

The local cotton merchant was an important purchaser of cotton from growers in most of the markets studied. Almost 42 per cent of the total volume of purchases in all markets combined were made by buyers of this type. Over 90 per cent of the purchases in Oak Grove were made by local cotton merchants. The proportion was 70 per cent at Natchitoches, 48 per cent at Minden, 46 per cent at Ferriday, and 31 per cent at Winnsboro and Ruston. However, only 12 per cent of the volume purchased at Mansfield and 1 per cent at Alexandria was made by this type of buyer.

The largest total volume of cotton for the eight markets combined was handled by representatives of central market cotton merchants. These buyers work for large firms located in central markets, receiving a commission or salary for their services. A portion of their purchases may be made from supply merchants, ginners, and other buyers but most of it is usually made direct from growers.

Almost 50 per cent of the total volume of purchases in the markets studied were made by buyers of this type. They were important in all of the markets studied except Oak Grove. Over 90 per cent of the purchases at Alexandria and 86 per cent of those at Mansfield were made by representatives of central market firms. The volume of such buyers made up approximately 29 per cent of the total at Ferriday and Natchitoches.

FACTORS RELATED TO CHOICE OF OUTLET

It is impossible to account completely for differences in the extent to which various market outlets are used by growers in marketing their cotton. A few factors may be pointed out, however, which influence to some extent a grower's choice of outlet.

Size of Producer

There seems to be some relationship between the size of crop handled by the producers and the proportion of cotton placed in the government loan. For instance, producers of 15 bales or less sold a larger proportion of their cotton outright than they placed in the loan. This was also true to a marked degree for producers of 101 bales or more. In contrast to this, those growers who produced from 16 to 100 bales placed more than half of their cotton in the loan (Table 4).

TABLE 4. PER CENT OF COTTON PLACED IN LOAN AND SOLD TO DIFFERENT TYPES OF BUYERS, BY SIZE OF GROWER, 1940-41 SEASON.

Number of bales per grower	Number of growers	Total number of bales	PER CENT DISPOSED OF BY:				
			Placing in loan	SALES TO:			Still in grower's possession
				Independent buyers	Commission buyers	Salaried buyers	
1-5	65	191	42.9	40.8	6.3	7.3	2.7
6-15	56	519	47.6	31.6	2.7	17.1	1.0
16-30	26	545	56.3	26.4	8.1	6.8	2.4
31-50	10	380	52.9	9.2	22.9	6.3	8.7
51-100	12	814	51.6	21.6	3.9	22.9	0.0
Over 100	15	3,514	17.0	12.4	50.9	16.7	3.0
TOTAL	184	5,963	31.1	17.3	33.2	15.7	2.7

There was a marked tendency for small growers to sell more of their cotton to independent buyers while large growers made extensive use of commission and salaried buyers. Independent buyers in this case included most of the supply merchants and ginner buyers as well as local independent cotton merchants. About one-half of the total number of bales of cotton were purchased by commission, and about one-fourth each by independent and salaried buyers. However, from the standpoint of the number of farmers with whom they dealt, the independent buyers were by far the most important. Approximately two-thirds of the farmers had 15 bales of cotton or less to sell. Their total sales amounted to only 11.9 per cent of the sales of the entire group.

It is common knowledge that advantages in selling may be realized through selling in lots containing as many bales as possible. A grower having as many as 50 bales in one lot is in a considerably better position to bargain effectively with buyers than one who has only 2 or 3 bales to sell. Also, less trouble and expense is involved on the buyer's part, especially if the cotton is of uniform quality. The majority of growers are forced to sell in small lots, however, because their production is small. Also most small growers do not sell all of their cotton at one time, consequently a large proportion of the total is sold in lots containing from one to four bales. Ginner-buyers and supply merchants purchase most of their cotton in lots of this size (Table 5).

Approximately 37 per cent of all transactions made by growers in the eight markets involved only 1 bale. Over 70 per cent of the transactions were for lots of 4 bales or less. However, the larger operators in the Delta tended to sell their cotton in lots varying in size from 25 to over 200 bales.

TABLE 5. NUMBER OF TRANSACTIONS* INVOLVING SPECIFIED NUMBER OF BALES OF COTTON, LOUISIANA, 1940-41 SEASON.

No. of bales	Mansfield	Minden	Ruston	Oak Grove	Winnsboro	Ferriday	Natchitoches	Alexandria	Total	Per cent of total
	(Number of transactions)									
1	25	18	61	36	24	9	4	13	190	37.1
2	8	11	19	19	13	2	11	15	98	19.1
3	6	5	3	7	11	2	6	2	42	8.2
4	3	12	5	5	4	5	2	0	36	7.0
5	1	2	3	3	2	0	6	1	18	3.5
6	3	2	0	0	2	1	1	7	16	3.1
7	0	0	0	1	2	1	1	0	5	1.0
8	0	2	0	0	4	1	4	2	13	2.5
9	0	2	4	0	1	0	0	0	7	1.4
10	0	0	3	0	0	1	7	1	12	2.3
11	0	0	0	0	0	0	3	0	3	0.6
12	1	1	0	1	1	0	4	2	10	2.0
13	0	0	0	0	0	0	1	0	1	0.2
14	0	0	0	1	0	0	1	1	3	0.6
15	1	0	0	0	0	2	3	1	7	1.4
16	0	0	0	0	0	0	2	0	2	0.4
17–25	3	0	0	1	2	2	3	0	11	2.1
26–50	2	4	0	2	1	7	3	0	19	3.7
51–100	1	0	0	0	0	5	4	0	10	2.0
101–200	0	0	0	1	0	3	2	1	7	1.4
201 over	0	0	0	0	0	1	0	1	2	0.4
TOTAL..	54	59	98	77	67	42	68	47	512	100.0

*Includes cotton placed in loan.

Number of Buyers Interviewed Before Sale or Placing in Loan

The practice of getting bids from more than one buyer before making a sale is a method used by many growers in bargaining with buyers. This procedure may be useful in helping the farmer get what his cotton is worth, provided effective competition exists between buyers. In the markets considered, about 35 per cent of the growers interviewed only one buyer before making a sale and 33 per cent interviewed two buyers. Less than eight per cent obtained bids from four or more buyers. A considerably larger proportion of those who placed their cotton in the loan saw only one buyer than did those who sold outright.

The proportion of growers selling after obtaining a bid from only one buyer was above 50 per cent at Mansfield, Minden, and Ruston, all of which were hill markets and below 33 per cent in the delta markets at Oak Grove, Winnsboro, Ferriday, Natchitoches, and Alexandria. This seems to be largely a result of the fact that the production per grower was generally smaller in the hill sections than in the delta regions. There was a tendency for a larger proportion of the small operators to interview only one buyer before selling than was true of the larger growers. About 37 per cent of those producing five bales or less and 40 per cent of those producing from 6 to 15 bales obtained bids from only one buyer before making a sale as compared with 30 per cent or less of those with more than 30 bales (Table 6).

TABLE 6. Number of Growers Interviewing Specified Number of Buyers Before Selling or Putting Cotton in Government Loan, by Size of Grower, 1940-41 Season.

Size of grower	Number of buyers interviewed									
	Before making sale					Before putting in loan				
	Total	1	2	3	4 or more	Total	1	2	3	4 or more
	(Number of growers)									
1-5	46	17	15	9	5	26	10	7	6	3
6–15	43	17	19	7	0	37	17	14	6	0
16–30	16	5	4	6	1	17	6	4	5	2
31–50	4	1	1	2	0	6	3	2	1	0
51–100	10	3	3	3	1	8	5	1	2	0
101–over	11	3	1	4	3	2	1	0	0	1
Total...	130	46	43	31	10	96	42	28	20	6
Per cent....	100.0	35.4	33.1	23.8	7.7	100.0	43.8	29.2	20.8	6.2

Length of Time Between Picking and Sale of Cotton

Many cotton growers, particularly those who produce only a few bales, sell their cotton almost immediately after ginning. Nearly one-third of the growers producing from 1 to 5 bales sold their crop within one day after ginning, and an additional 40 per cent sold within three days. In contrast only 3 of the 27 growers having more than 50 bales of cotton sold immediately after ginning. In general a larger proportion of the growers sold soon after ginning in the "hill" markets than did those located in the delta regions.

The two reasons given most frequently by growers for selling or putting their cotton in the loan at the particular time they chose were: (1) to meet immediate obligations, and (2) the price was believed to be most favorable. As might be expected, a larger proportion of small growers sold to meet obligations while more of the large producers marketed at the time they considered the price most favorable. More than one-half of those producing five bales or less marketed their cotton because they had debts to meet (Table 7). This was the case with only 20.0 per cent of those producing more than 100 bales. On the other hand these large producers made 60 per cent of their sales when they thought the price was most favorable. A small number of growers sold at the time that was most convenient, and a few others just because they wanted to get the cotton out of the way.

TABLE 7. REASONS FOR GROWERS SELLING OR PUTTING COTTON IN LOAN AT TIME CHOSEN, BY SIZE OF GROWER, 1940-41.

Number of bales	Total number	Reasons for selling: Meet immediate obligations	Price most favorable	Just to dispose of cotton	Most convenient time	Other
		(Number of growers)				
1–5	65	36	13	5	5	6
6–15	62	24	25	4	2	7
16–30	28	9	16	0	0	3
31–50	9	1	5	0	1	2
51–100	13	4	7	0	1	1
101–over	20	4	12	0	1	3
TOTAL	197	78	78	9	10	22
Per cent	100.0	39.6	39.6	4.6	5.1	11.1

Growers' Reasons for Choice of Outlet

One consideration is far more important to the grower than all others in choosing an outlet for his cotton. Over 80 per cent of all growers interviewed chose the outlet through which they thought they obtained the highest price for their cotton. The only other consideration that was of any importance was convenience. Approximately 13 per cent of the growers stated that they marketed their cotton at the most convenient place. Convenience was a reason given more often by small growers than by those with large amounts of cotton to sell. Only a small number of growers sold their cotton to particular buyers because they were indebted to them or because they were confident that the buyer would treat them fairly (Table 8).

It is significant that even though a considerable proportion of the growers sold their cotton to meet immediate financial obligations, as shown previously, only a very small number were indebted to the buyer to whom they sold.

TABLE 8. REASONS FOR GROWERS' CHOICE OF BUYER OR AGENCY IN MARKETING HIS COTTON, 1940-41 SEASON.

Number of bales	Total	Reasons for selling: Convenience	Offered highest price	Indebted to buyer	Confidence in buyer	Other
	(Number of growers)					
1–5	68	11	53	3	0	1
6–15	63	12	46	1	2	2
16–30	26	1	22	1	1	1
31–50	10	0	10	0	0	0
51–100	13	1	12	0	0	0
101–over	17	1	15	0	0	1
TOTAL............	197	26	158	5	3	5
Per cent..........	100.0	13.2	80.2	2.5	1.6	2.5

MARKETING PRACTICES OF GROWERS

It is a common practice in many parts of Louisiana for the ginner to haul the growers' cotton to the warehouse almost immediately after ginning. In these areas only a small proportion of the cotton remains on the gin platform for even one night. This is especially true in the Mississippi and Red River deltas. In some of the hill markets the gin yard and farm are relatively important places of storage. Also in these sections a large proportion of the cotton is sold immediately by the growers and the problem of storage does not exist for these farmers. The percentage of growers using various places of storage is shown in Table 9.

Most transactions involving the sale of cotton by growers are based on samples representing the bales being sold. In Louisiana about three-fourths of the farmers used samples taken by the warehouseman and about one-half of the remainder sold on the basis of samples taken by the buyer. In areas where the cotton is hauled immediately by the ginner to the warehouse, the warehouse samples are returned to the gin together with the receipts, where they are obtained by the growers. The growers present samples and warehouse receipts to prospective buyers when they wish to sell. In such cases the buyers rarely see the bales they purchase. Such a system works efficiently when there is close coordination between ginners, warehousemen, and buyers. When cotton is sold at the gin or country store, the sale is usually, although not always, based on samples cut from the bale by the buyer. A small number of growers used samples taken by the ginner. In exceptional cases the grower may sell his cotton on samples taken himself.

Since questions frequently arise regarding the accuracy of the weight assigned to a bale of cotton, the agency assessing the weight upon which

TABLE 9. The Proportion of Growers Using Various Places of Storage, Sampling Agencies, and Types of Weights, Specified Markets in Louisiana, 1940-41.

Market	Number of growers	Place of storage				Agency taking sample			Type of weight		
		Public warehouse	Farm	Sold immediately	Other	Public warehouse	Buyer	Other	Public warehouse	Gin	Other
		(Per cent of growers)									
Mansfield	24	13	54	8	25	50	33	17	61	9	30
Minden	23	27	27	32	14	50	12	38	88	12	0
Ruston	26	56	0	33	11	55	18	27	68	32	0
Oak Grove	21	91	0	5	4	91	5	4	91	9	0
Winnsboro	23	96	4	0	0	100	0	0	96	4	0
Ferriday	22	96	0	0	4	96	0	4	96	4	0
Natchitoches	24	66	19	0	15	80	20	0	88	12	0
Alexandria	21	80	8	4	8	95	0	5	100	0	0
TOTAL	184	65	14	10	11	76	12	12	85	11	4

a sale is based is of some importance to both buyers and sellers. Final settlements with 85 per cent of the growers were based on the weights of public warehouses which were licensed and bonded. This was to be expected since approximately three-fourths of the growers used such warehouses as places of storage. Also a few transactions at gins or country stores were made with the understanding that final settlement was to be made on warehouse weights. About 11 per cent of the growers sold their cotton on gin weights and 4 per cent on public weigher's weights. The only market where weights by the latter type were important was Mansfield. Sales on gin weights were of some importance at Minden, Ruston, and Natchitoches.

Cotton producers may participate in the transactions involved in the sale of their cotton at a number of different places. The place of sale depends a great deal upon the type of buyer to whom the cotton is sold. Most of the sales to local cotton merchants or representatives of central market firms were made at the buyer's office, although as has already been pointed out, these types of buyers sometimes purchase a portion of their cotton from growers at gins and country stores. Sales to supply merchants were usually made at their stores and to ginner-buyers at the gin.

Table 10 shows that in the markets studied growers sold 65 per cent of their cotton at the buyer's office, 16 per cent at warehouses and 15 per cent at stores. Only a very small proportion of the sales was made on the street, at gins, or on farms. It is difficult to interpret the data for some of the individual markets since such large proportions of the cotton was placed in the government loan that conclusions regarding outright sales must be based on a small number of bales. On the basis of the limited

TABLE 10. THE PROPORTION OF SALES AND DELIVERIES OF COTTON MADE BY GROWERS IN VARIOUS PLACES, SPECIFIED MARKETS IN LOUISIANA, 1940-41.

Market	Number of bales	PLACE OF SALE				PLACE OF DELIVERY			
		Buyer's office	Ware-house	Store	Other	Ware-house	Store	Gin	Other
		(Per cent of bales sold)							
Mansfield.....	27	0	0	4	96	4	7	11	78
Minden.......	259	3	0	97	*	5	95	0	0
Ruston........	185	32	8	7	53	51	0	49	0
Oak Grove....	328	94	0	6	0	94	0	6	0
Winnsboro.....	163	92	0	7	1	93	0	7	0
Ferriday......	1,370	88	12	0	*	100	0	*	0
Natchitoches...	1,129	29	40	27	4	96	0	0	4
Alexandria.....	480	100	0	0	0	100	0	0	0
TOTAL....	3,941	65	16	15	4	89	6	3	2

*Less than 0.5 per cent.

information the buyer's office was the most important place of sale at all except four markets. At Mansfield sales on the street seemed most important. The majority of the sales of growers were made at stores at Minden, at gins at Ruston, and at warehouses at Natchitoches.

The place of sale and place of delivery by the grower of the cotton involved in a sale often are not the same. When the sale is made at the buyer's office it is usually based on warehouse samples and the place of delivery is the warehouse. Even when sales were made at gins or country stores, delivery occasionally was made at a warehouse. Almost nine-tenths of the total deliveries made by growers were at warehouses. The gins, stores, and other places were of minor importance, except at Mansfield, Minden and Ruston.

GROWER'S KNOWLEDGE OF QUALITY

Quality should have a great deal to do with the price a grower receives for his cotton, although in many cases buyers appear to give it very little consideration. Since this is the case, it is important that cotton growers have some knowledge of the quality of the cotton they are selling and of its value under existing market conditions. This is especially true if the quality is better than the average of the community.

Practically all growers must depend upon sources other than themselves for information regarding the quality of their cotton if such information is to be had. Of the 184 growers interviewed, only five claimed that they could accurately grade and staple cotton. More than 30 per cent of the growers stated that they had no knowledge of the quality of their cotton when they sold it, and another 25 per cent knew only the class placed on it by the buyer. Those who had no information usually stated that the buyer looked at a sample of their cotton but did not mention its quality. Only a price was quoted. Other sources from which information regarding quality was obtained were cooperative associations, classification furnished growers by ginners who submitted samples to the Federal Government for its grade and staple statistics work, classification furnished direct to members of one-variety cotton improvement groups by the Federal Government under the Smith-Doxey Act, and classification furnished by the Federal Government to growers who placed cotton in the government loan. All cotton which was placed in the government loan had to be classed by a federal board of examiners. Two classing offices were set up in the state in 1940, one at Monroe and one at Shreveport for the purpose of classing cotton for the government loan. In addition an office at Alexandria which was opened for the purpose of classing cotton belonging to members of cotton improvement groups and the supervising office in New Orleans, classed cotton which was to go into the loan. The Smith-Doxey class which was furnished members of cotton improvement groups could also be used for loan purposes. The Louisiana Cotton Cooperative Association had arrangements with the Commodity Credit Corporation making it possible for them to advance money to growers on their own class and later to have the cotton reclassed by the Board of Examiners in New Orleans before it was actually placed in the loan.

About 4 per cent of the growers had received information regarding the quality of their cotton from a cooperative association before selling it and another 3 per cent used the cooperative class in placing their cotton in the loan. Approximately 2 per cent had received information regarding the quality of their cotton from gins which submitted samples to the United States Department of Agriculture for its statistical purposes. Eleven per cent either placed their cotton in the government loan on the class furnished them through the Smith-Doxey Act or sold their cotton with a class from this source in their possession. About 23 per cent of the growers placed their cotton in the loan on the class furnished them by a Federal Board of Examiners for this purpose (Table 11).

In general small growers sold a larger proportion of their cotton without having a knowledge of its quality than did the larger ones. Approximately 44 per cent of the growers producing from 1 to 5 bales sold without having information regarding quality. This was also the case with more than 31 per cent of those producing from 6 to 30 bales. A considerably larger proportion of those producing more than 30 bales had information concerning the quality of their cotton either from buyers or other sources prior to marketing. However, it should be pointed out that information from buyers regarding quality may be badly biased.

In the individual markets the proportion of growers who sold their cotton without having any knowledge of its quality varied from 61.9 per cent at Alexandria to none at Minden. At Ruston 62.5 per cent of the growers had no information concerning the quality of their cotton except that obtained from the buyers. At Minden 40 per cent of the growers used the Smith-Doxey class.

TABLE 11. MOST COMMON SOURCE OF THE GROWERS' INFORMATION AS TO QUALITY OF THEIR COTTON BY SIZE OF GROWER, 1940-41.

Number of bales	Total	SOURCE OF INFORMATION CONCERNING QUALITY					
		Buyer's	Cooperative Association	Grade and staple statistics	Smith-Doxey	Government loan	None
		(Number of growers)					
1–5	68	16	2	0	5	15	30
6–15	66	17	5	0	7	16	21
16–30	32	6	3	2	2	9	10
31–50	11	2	1	1	4	2	1
51–100	14	7	0	1	3	3	0
101 and over	19	5	4	1	3	4	2
TOTAL.........	210*	53	15	5	24	49	64
Per cent........	100.0	25.2	7.2	2.4	11.4	23.3	30.5

*There were 26 growers who obtained information from more than one source.

GROWERS' KNOWLEDGE OF MARKET CONDITIONS

In addition to having information regarding the quality of their cotton at the time of sale, it is important that growers have accurate knowledge of prices for different qualities of cotton both in the local and in central markets. This is especially true in markets where, because of a limited number of buyers or for other reasons, competition for growers' cotton is not keen.

Over 46 per cent of the growers interviewed stated that information was available to them when needed regarding the price of cotton futures, and over 48 per cent had access to price quotations from some spot market. However, only 7 per cent had ready access to information regarding premiums and discounts for quality. Lack of the latter information is serious because without it the grower cannot estimate accurately the value of cotton of his particular grade and staple length. Also the quotations for futures and spot markets and for premiums and discounts apply to central markets and must be converted to the basis applicable to the local market by deduction of freight and handling charges before they are of practical use to the farmer. The process followed in making these calculations is not understood by many growers and as a result central market quotations are of limited value to them.

Local price information often is obtained by the grower from the buyer to whom he sells his cotton, from other buyers, or from other growers. The dissemination of such information in this manner serves a very useful purpose because it tends to make the market more competitive. However, it is not always reliable in individual cases. Approximately 35 per cent of the growers obtained price information from buyers other than the one to whom the sale was made, and about 23 per cent also obtained information from other growers. Another source of information which was used by about 44 per cent of the growers was the daily newspapers. The radio was used by about 20 per cent of those interviewed. A bulletin board on which spot and futures quotations and quality premiums and discounts were posted was used by 6 of 23 growers at Minden (Table 12). With the exception of the possible use of bulletin boards the radio is probably the best source of current price information which is available to growers. However, radio reports do not always include quotations for different qualities. Premiums and discounts sent through the mail by the Agricultural Marketing Service are useful when used in conjunction with other quotations obtained just before the sale is made.

TABLE 12. GROWERS' SOURCE OF PRICE INFORMATION, SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Total number	SOURCE OF PRICE INFORMATION						
		Daily paper	Other buyers	Bulletin board	Radio	Other growers	No information available	Other
		(Number of growers)						
Mansfield	24	11	3	0	6	4	3	4
Minden	23	7	2	6	3	0	4	3
Ruston	28	10	0	0	2	0	4	1
Oak Grove	21	7	18	0	7	13	0	1
Winnsboro	24	10	9	0	5	11	3	0
Ferriday	20	10	14	0	3	8	0	4
Natchitoches	24	13	12	0	8	4	4	0
Alexandria	20	13	7	0	3	3	3	2
TOTAL	184	81	65	6	37	43	21	15
Per cent		44.0	35.3	3.3	20.1	23.4	11.4	8.2

PRACTICES OF LOCAL COTTON BUYERS

The local buyer's primary function is that of beginning the task of concentrating cotton into large even-running lots. This process is continued by others until the cotton reaches the markets in which it is consumed. From numerous farmers, the local buyers gather each season's crop into quantities sufficiently large to be handled economically by large cotton merchants. This service is an indispensable part of the marketing procedure. Since the local buyers are constantly in contact with the cotton producers, many of their practices directly affect the producers and the prices they receive for cotton.

Volume of Purchases

Buyers in the eight markets studied handled more than 150,000 bales of cotton. Purchases from farmers accounted for approximately 58 per cent of this amount, 13 per cent represented purchases from other buyers, and 29 per cent was handled for the government loan (Table 13). Purchases from other buyers were made largely from supply merchants and ginner buyers by the larger operators for whom cotton buying was a major business enterprise. In Mansfield and Oak Grove no trading was carried on among buyers, while over 50 per cent of the cotton purchased in Alexandria was obtained from other buyers.

TABLE 13. Amount of Cotton Handled by Local Buyers in Specified Markets in Louisiana, 1940-41.

Market	Number of buyers	Number of bales handled			
		Total	Purchased from		Handled for loan
			Farmers	Other buyers	
Mansfield	4	4,140	4,110	0	30
Minden	7	17,000	7,200	3,700	6,100
Ruston	12	12,549	7,049	4,400	1,100
Oak Grove	4	6,553	6,553	0	0
Winnsboro	7	49,929	30,567	2,000	17,362
Ferriday	5	11,100	9,175	1,925	0
Natchitoches	7	31,525	19,275	2,250	10,000
Alexandria	5	20,521	4,875	5,768	9,878
Total	51	153,317	88,804	20,043	44,470
Per cent		100.0	57.9	13.1	29.0

In addition to their purchases, many of the buyers assisted growers in filling out papers which were required before cotton could be placed in the government loan. Prior to October 31, fees were usually charged for such assistance amounting to from $0.25 to $1.50 per bale. On October 31, the Commodity Credit Corporation issued an order stating that no charges could be made for filling out loan papers since compensation for all necessary services in connection with the completion of the loan form was already covered in the interest rate allowed lending agencies and by certain charges by the warehouses to which the cotton was delivered.

Local buyers assisted in filling out loan papers for more than 44,000 bales of cotton. Indications are that additional fees were charged by the buyers for a large part of this amount. In some markets it appears that nearly 50 per cent of the volume of cotton from which buyers received an income was cotton for which loan papers were filled out.

Business Relationships of Buyers

Buyers in local markets ordinarily carry on their buying activities as independent business enterprises or work on salary or commission for central market cotton merchants. Those who operate independently usually also operate or are financially interested in other types of businesses. Their buying activities may be either a major or minor part of their business. Also it is not unusual for salaried and commission buyers to have other business interests, but buying cotton is usually a major enterprise with them. Salaried buyers are ordinarily paid a fixed salary for their services by some central market merchant. In addition to a salary they may also receive a percentage of their purchases as a commission or they may receive a bonus. Commission buyers receive the largest portion of their compensation for buying in the form of a commission but may also receive a fixed guarantee or a bonus.

Approximately 48 per cent of the cotton purchased in the markets studied was by independent buyers. About 42 per cent of the purchases were made by salaried buyers and 10 per cent by individuals buying on commission (Table 14). The relative volume of purchases by independent buyers was greatest at Oak Grove, Winnsboro, Ferriday, and Natchitoches, and least at Alexandria and Mansfield. At Mansfield over 86 per cent of the purchases were made by commission buyers.

Other business enterprises engaged in by local buyers are generally related in one way or another to cotton. Of the 51 buyers, whose activities were studied, 22 also furnished supplies to growers, 21 were financially interested in farms, and 14 in cotton gins. Some were engaged in as

TABLE 14. VOLUME OF COTTON PURCHASED BY INDEPENDENT, SALARIED, AND COMMISSION BUYERS IN SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Number of buyers	NUMBER OF BALES PURCHASED			
		Total	Independent buyers	Salaried buyers	Commission buyers
Mansfield	4	4,110	565	0	3,545
Minden	7	10,900	4,950	4,800	1,150
Ruston	12	11,449	6,050	4,799	600
Oak Grove	4	6,553	6,553	0	0
Winnsboro	7	32,567	12,567	20,000	0
Ferriday	5	11,100	7,400	3,200	500
Natchitoches	7	21,525	13,300	3,075	5,150
Alexandria	5	10,643	875	9,768	0
TOTAL	51	108,847	52,260	45,642	10,945
Per cent		100.0	48.0	41.9	10.1

many as four or five different types of business activities. The numerous activities engaged in by cotton buyers may partially be explained by the fact that buying cotton requires a person's attention only during a part of the year. Unless a very large volume is handled, income must also be obtained from other sources. For those to whom buying cotton is a sideline, the enterprise is probably engaged in because it happens to fit well into their major business. This is especially true for supply merchants.

Source of Funds for Financing Purchases

As a general rule local buyers do not finance all of their own cotton purchases. The capital needed for making such purchases is seasonal and can best be furnished by commercial lending agencies. Approximately 25 per cent of the buyers contacted used their own funds at least partially in making purchases. Most of these were small supply merchants or ginners who bought only a few bales. The local bank was used as a means of financing by 43 per cent of the buyers. Most of those who used this source were independent buyers, although a few salaried or commissioned buyers also made use of local banks. The common procedure is for the buyer to give the grower a draft on the local bank in payment for his cotton. Warehouse receipts are used as collateral.

Representatives of central market cotton merchants are financed by the firm which they represent, usually through arrangements with a local bank. The buyer generally presents the grower with a draft on the central market firm which is honored by a local bank. Almost 40 per cent of all the buyers used this method of payment. Only in exceptional cases are local buyers financed by out of town banks.

Determination of Quality

Practically all buyers made at least a superficial attempt to determine the quality of a bale of cotton before purchasing it. According to the buyers interviewed only 0.4 per cent of their volume of purchases was made without first determining the quality. However, none of the buyers purchased cotton on any class other than their own. Moreover, it is probable that a large number of buyers determined quality only in a general way and did not place an accurate class upon the cotton. Of the 51 buyers interviewed, 31 had no means whatever of checking against official grade standards, and 36 had no check against staple standards. It is common knowledge among classers that standards for grade and staple length must be constantly referred to if their classing is to remain accurate. Only 8 buyers owned and 12 buyers had access to any of the staple types. Cotton classing is at best rather inexact, and without standards which can be referred to constantly its accuracy decreases considerably. Quality determination then becomes a matter of making generalized distinctions between wide variations in quality (Table 15).

Most of those buyers who owned or had access to standards for grade were limited to the four grades from Low Middling to Strict Middling. Three buyers had access to all the standards which were available at nearby educational institutions or government classing offices. The range of staple types owned by buyers or to which they had access was somewhat greater. These ranged from $\frac{7}{8}$ to $1\frac{1}{8}$ inches for 8 buyers. However, these buyers did not possess all of the types within that range. Buyers in short staple sections usually owned or had access to the shorter staple types only. The same was true of the long staple types in the longer staple sections.

TABLE 15. NUMBER OF BUYERS OWNING OR HAVING ACCESS TO GRADE AND STAPLE STANDARDS, SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Total number	No means of checking against grade standards	Owning grade standards	Have access to grade standards	No means of checking against staple types	Owning staple types	Have access to staple types
	(Number of buyers)						
Mansfield	4	4	0	0	4	0	0
Minden	7	4	1	2	3	2	2
Ruston	12	7	1	4	10	1	1
Oak Grove	4	2	2	0	3	1	0
Winnsboro	7	5	2	0	4	3	0
Ferriday	5	2	0	3	4	0	1
Natchitoches	7	4	2	1	5	1	1
Alexandria	5	3	0	2	3	1	1
TOTAL	51	31	8	12	36	9	6

Merchandising Practices

In general, procedures followed by local buyers who themselves sell the cotton they purchase are rather uniform. Most buyers make direct sales rather than operating through brokers, sell at a fixed price, shift the risk of price changes to second buyers by selling almost immediately after purchase, and deliver the cotton to second buyers at the local markets. Therefore, it seems that the local buyer's function is mainly that of gathering cotton from growers into large enough quantities to be handled economically by larger cotton merchants. The greater part of the risks involved in holding and in transportation are shifted to these larger buyers.

Salaried and commission buyers rarely sell the cotton they purchase but simply report their purchases to the home office of the firms they represent. This was true of 16 of the 51 buyers interviewed. Practically all of those who made their own sales were independent buyers. There were 3 local buyers who made sales to central market merchants and occasionally to mills through brokers. The operations of these buyers were usually larger in volume than those of the average local buyer. To a certain extent they performed more of the services, such as transportation and storage which were ordinarily performed by merchants in the central markets, than did the other local buyers.

The method used by the remainder of the local buyers was that of making sales direct to central market firms, without the assistance of a broker. Such sales were made either to some representative of the firm who was in the vicinity or by wire or telephone to the central office of the firm.

To avoid risk of loss from price declines, local independent buyers ordinarily sold their cotton the same day that it was purchased. Salaried and commission buyers simply reported their purchases daily to the home office in order that the firm which they represented might take whatever steps were necessary for protection from price declines. Selling futures as a hedge against purchases was used only to a slight extent by local buyers.

Approximately 44 per cent of the total purchases of local buyers were sold the day the purchase was made, and about 38 per cent were reported daily to central market firms by buyers who worked on salary or commission (Table 16). Hedging was used as a method of protection by local buyers only in the Natchitoches market. Only 17 per cent of the total purchases of buyers were left unprotected from adverse price changes for longer than one day. However, at Ferriday and Winnsboro the proportion was 40 and 44 per cent respectively.

TABLE 16. METHODS OF PROTECTION USED AGAINST PRICE DECLINES BY BUYERS IN SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Number of buyers	Total	Hedging	Selling daily	Report daily to home office	No protection
		(Per cent of purchases)				
Mansfield	4	100.0	0.0	50.0	50.0	0.0
Minden	7	100.0	0.0	58.0	40.6	1.4
Ruston	12	100.0	0.0	53.9	25.0	21.1
Oak Grove	4	100.0	0.0	68.7	25.0	6.3
Winnsboro	7	100.0	12.9	14.2	28.6	44.3
Ferriday	5	100.0	0.0	37.6	22.4	40.0
Natchitoches	7	100.0	0.0	25.0	70.0	5.0
Alexandria	5	100.0	0.0	45.0	40.0	15.0
TOTAL	51	100.0	1.6	44.0	37.7	16.7

The local cotton buyer in Louisiana rarely shipped the cotton he bought. In practically all cases, the terms of his sales were such that the cotton became the property of larger merchants while it was still in the local market. Therefore, risks involved in transportation usually were not borne by the local buyer. The most usual type of sale was one in which possession passed to the second buyer while the cotton was in the local warehouse. Such a sale is commonly designated "ex warehouse." A type of sale used less frequently was "F. O. B. shipping point," under the terms of which the local buyer was responsible for the expense of loading the cotton into cars ready for shipment.

Approximately three-fourths of the buyers, who sold the cotton which they purchased, sold under ex warehouse terms, at least part of the time. About 28 per cent sold under F. O. B. shipping point terms all or part of the time. Only in individual instances, did buyers make a practice of using other terms of sale, such as F. O. B. destination, F. O. B. port, and delivered.

In selling their cotton, local buyers usually agreed upon the exact price with the person to whom they were selling at the time the transaction was made. A sale in which the price is arrived at in this manner is termed a sale at a fixed price. Some local buyers, however, frequently sold without fixing a definite price at the time of sale. At the time of sale an agreement was made that the local cotton buyer, who was selling the cotton, had the right to fix the price, based on some market quotation, at any particular time he wished. Such an arrangement is often made when in the opinion of the local buyer, the price of cotton is likely to rise later in the season. All 35 buyers who sold the cotton they purchased made all or a part of their sales at fixed prices. Only 5 made some sales on sellers call.

Sales of almost all cotton by buyers in the local markets studied were made on the basis of local compress or warehouse weights. This is to be expected since these points are all served by licensed and bonded warehouses. Only two buyers made sales based on other types of weights. In one case a portion of the buyers' sales were based on central market compress weights and in another case on mill weights.

Quality Determination by Firms Purchasing from Local Buyers

Firms purchasing from local buyers used various methods of determining the quality of the cotton they purchased. To some extent the method used depended upon the firm's opinion of the local buyer's ability and integrity. Twenty-two of the 35 buyers who made outright purchases and sales of cotton, submitted samples to the buying firm as a basis for all or a portion of their sales (Table 17) . Seven based at least a portion of their

TABLE 17. MEANS BY WHICH THE QUALITY OF COTTON WAS DETERMINED BY FIRMS PURCHASING FROM LOCAL BUYERS IN SPECIFIED MARKETS IN LOUISIANA, 1940-41 SEASON.

Market	Number of buyers	METHOD OF QUALITY DETERMINATION BY PURCHASING FIRM				
		Sample submitted by buyer	Firms type	STANDARD DESCRIPTION WITH CLASSIFICATION		Without examination by firm
				By take-up man	After cotton was shipped	
	(Number of buyers)					
Mansfield	2	0	0	0	2	0
Minden	5	4	0	0	1	0
Ruston	9	9	0	1	1	0
Oak Grove	4	3	0	0	1	1
Winnsboro	5	0	5	0	0	0
Ferriday	4	4	0	0	1	0
Natchitoches	3	0	2	0	2	0
Alexandria	3	2	0	0	1	0
TOTAL	35	22	7	1	9	1

sales on a type sample prepared by the buying firm and used by the local buyer as a guide to the quality of cotton desired. There were 10 buyers who sold on the basis of a description of the cotton according to some standard. However their cotton was later reclassed after the cotton was shipped. Only one local buyer sold without some type of examination of the quality of the cotton being made by the buying firm.

SUMMARY AND CONCLUSIONS

From the point of view of cotton farmers the best system of local markets would be one that gave them the highest price that current market conditions justified for each bale of cotton they had to sell. This is not an easy ideal to achieve. It would require markets in which both buyers and sellers were fully informed concerning all conditions affecting the market and in particular with respect to the quality of each bale of cotton they bought or sold and the current central market valuation of each quality. In addition vigorous competition would have to be present in the local markets.

The data presented in this report indicate that local cotton markets in Louisiana are a long ways from possessing these ideal conditions. For instance, 30 per cent of the producers had no knowledge of the quality of their cotton when they sold it and another 25 per cent knew only what the buyer told them concerning the grade and staple length of their bales. These percentages were even higher for small producers who had only a few bales to sell. It is likely that free classification of cotton for certain growers under the terms of the Smith-Doxey Act caused these percentages to be lower in 1940 than they had been in previous years. A further development of the Smith-Doxey program would offer possibilities for further improvement in cotton growers' knowledge of the quality of their cotton.

Another weak point, from the grower's standpoint, in selling cotton is the lack of adequate information concerning prices. While nearly one-half of the producers had available current information concerning the price of futures and the spot prices of middling 15/16 inch cotton, only 7 per cent had access to information regarding premiums and discounts for various grades and staple lengths. Without all of this information producers are necessarily in a poor bargaining position.

There were a number of different types of buyers in the local markets with whom producers could do business. Their choice of buyers seemed to be related to a number of factors: (1) In making outright sales there was a marked tendency for small growers to sell a larger proportion of their cotton to independent buyers than did the larger operators who more commonly sold to representatives of central market cotton merchants; (2) small operators placed a much larger proportion of their cotton in the government loan than did the other growers; (3) there was a tendency for the larger producers to obtain bids from more buyers before making a sale than did the smaller growers; (4) the smaller growers sold more of their cotton immediately or within a few days after ginning; (5) the necessity for meeting immediate financial obligations was a more important reason for selling at the time chosen for small than it was for large growers; (6) while a large majority of all cotton producers gave as their reason for choosing a particular buyer the fact that they obtained the highest price from him, this reason was more common among the large growers than among the small ones. It is apparent that the smaller growers were at a distinct disadvantage in several respects in dealing with the buyers as compared with the farmers who had a larger number of bales to sell.

Almost half of the total volume of purchases in the local markets studied were made by independent buyers, somewhat more than 40 per cent by salaried buyers and about 10 per cent by persons buying on commission. Most of the local buyers were also engaged in other businesses, which had some connection with the cotton industry. In some instances, particularly where buyers sold or furnished supplies to cotton growers, there appeared to be an intimate connection between cotton buying and these other activities. Probably a considerable proportion of the independent buyers were engaged in the business of buying cotton because it fitted in well with their other business or perhaps actually helped to make that business more profitable than it would otherwise have been.

Practically all buyers at least made an attempt to determine the grade and staple length of a bale of cotton before purchasing it. However, it seems probable that a considerable proportion were not able to do this very accurately. About three out of every five local buyers interviewed had no means of checking their work against official grade standards or staple types. Most of the other buyers had access to the standards for only a few of the more common grades and staple lengths. One reason why local buyers were not in a position to do a better job of classing cotton was that it was a part-time job for most of them. Consequently the equipment, energy, and skill devoted to the cotton business was limited.

In general, local buyers performed only limited functions in connection with the marketing of cotton. Their most important services were in providing the farmers with cash when farmers sold to them and in assembling large enough quantities of cotton so that central market buyers could handle it economically. Most independent buyers sold very soon after purchasing cotton, frequently on the same day. Salaried and commission buyers simply reported their purchases to the home office of the firms they represented. Most of the independent local buyers delivered the cotton to second buyers at the local market, on the basis of local compress or warehouse weights. Thus the local buyers ordinarily assumed no responsibility in connection with moving the cotton out of the local market. Most of the local buyers were required to submit samples to the buying firm, although a few sold on the basis of type samples or standard description.

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New Mexico College of Agriculture
and Mechanic Arts

Louisiana Farm Laborers And Total War

By

Harold Hoffsommer

and

Ralph J. Ramsey

In Cooperation with the Bureau of Agricultural Economics, United States Department of Agriculture

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Neighbor Cooperation Such As This In Rice Threshing Will Help Solve the Farm Labor Problem

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS

W. G. Taggart, *Director*

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Louisiana Farm Laborers and Total War

HAROLD HOFFSOMMER AND

RALPH J. RAMSEY[1]

Farm Labor and the War Effort

It is not enough to say that our nation is engaged in a war. It is engaged in a *total war.* This means that every physical and human resource must be fitted into the niche where it can be of most service in winning the ultimate victory. Agriculture is obviously an important link in the victory chain. Secretary of Agriculture Wickard has said that "food will win the war, and write the peace." Despite the mechanization of warfare, armies still "march on their stomachs" and likewise it may be added, food greatly conditions the civilian morale and strength of the nations. American agriculture is charged with providing food and fiber not only for our own army and civilian population but with furnishing substantial supplies to our allies as well. Can agriculture meet the challenge?

Louisiana farmers are pledged to increases in production. At the same time they are faced with restrictions on machinery, fertilizer, seeds and other essential materials over which they have little control. Even more serious is the problem of labor which lies at the very root of all production. Fortunately, the opportunities for meeting the labor difficulties are more within the control of the farmer than the opportunities for surmounting the other handicaps mentioned. Heretofore, labor supply has not been a serious problem but now new elements have entered the picture. The demand placed upon Louisiana agriculture cannot be met without serious planning and intelligent extension of effort. Probably the most crucial phase of this planning concerns the utilization of agricultural manpower.

The Louisiana Farmers' Part

Increased crop acreages

In addition to the 1941 crop acreages and livestock productions, Louisiana farmers have been asked and have pledged themselves to produce 103,000 acres of soybeans, 50,000 acres of peanuts, 55,000 acres of rice, 5,000 acres of home garden, 2,000 milk cows, 28,000 beef cattle, 10,000 hogs, and 3,000,000 dozen eggs. Over and above these acreages an undetermined additional acreage of feed crops will be required to care for the increases in livestock and poultry.

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[1] Cooperative Agent with the Bureau of Agricultural Economics.

Men for the armed forces and war production

Additional acres require additional laborers. But that is not all. On the basis of a national armed force of six million, it is estimated that Louisiana will be called upon to supply 105,000 men, something like 65,000 of which will be drawn from rural areas. This represents only a part of the war need since probably another 50,000 will be needed to work in industries directly concerned with war production, roughly one-half of which must come from rural areas. In all, therefore, an estimated total of 90,000 will be drawn from Louisiana's rural population for war purposes. This is probably a conservative figure in view of the demand for laborers in private industries stimulated by war production activities. This indirect labor demand has been variously estimated, but for the United States as a whole the Committee on Labor of the Twentieth Century Fund estimates that for every new or unemployed worker added to the defense industries an additional person is added to non-defense employment. On this basis another 25,000 should be added to the 90,000 lost for agricultural work indicated above. Although the total drain on the agricultural labor supply from these various causes cannot be estimated with certainty, the above figures give ample evidence that Louisiana farmers are faced with problems which will demand their most serious attention.

War Time Demand for Farm Laborers

Labor needs for additional crops

In the "food for freedom" program, acreages for which have already been given, it is estimated that to plant, tend and harvest the various crops and to care for the extra livestock and poultry will require an increase of 2 million man days of labor of 10 hours each.[1] In view of the other demands at this time, will there be a sufficient number of farm laborers available to reach the production goals? The final answer to this question must be given in terms of months and local areas. But before proceeding with this analysis, the major problems can be considerably clarified by several statewide observations.

Seasonal nature of Louisiana's farm labor demand

Unfortunately, there are already two "bottlenecks" in the Louisiana farm labor situation: the first is that of satisfying peak season labor demands; the second, no less important, is the problem of efficiently using the available man power during the normally slack agricultural seasons. As the matter now stands, the Louisiana demand for farm laborers is highly seasonal. The food for freedom products to be produced in 1942 require a more steady labor supply throughout the year than the crops already under production. Although these additional crops will add somewhat to the peak labor demands, they use a relatively large number of laborers in what are now the off seasons and in this way tend to make more efficient use of the total labor power.

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[1] Estimates of labor requirements are based on studies made by the Department of Agricultural Economics, Louisiana State University, on labor actually expended for each crop and livestock enterprise by operation and by months. Although the estimates are not strictly applicable throughout the state due to differences in yields, degree of mechanization and methods of production, the variations for the purposes at hand are not significant. Average weather conditions and yields are assumed for 1942. The term *man month* is used to represent the equivalent of one man working 22 days of 10 hours each. It is realized that due to weather conditions and the lack of volume of work there will be many days of less than 10 hours and many months of only 10 or 15 days. The calculations are made on the basis of the maximum amount of work possible under ideal conditions.

It is, of course, obvious that the production of certain agricultural items demands a more continuous and less seasonal labor force than others. Conspicuous among those utilizing year around labor are livestock and poultry. Sugar cane, rice and hay (including soybeans and peanuts), particularly when combined with other crops, show a fairly steady labor demand throughout the year. Cotton, Louisiana's dominant crop, unfortunately presents a highly seasonal demand. Rice harvesting presents a slight peak in August and September and cane harvesting and planting during October, November and December. These peak demands are largely localized and present no statewide problem excepting that the rice harvest conflicts with cotton picking. Strawberry and commercial vegetable production is also localized.

The planting and cultivating of cotton, corn and vegetables from March to June and cotton picking in August and September represent the greatest demands for labor. Although cotton is usually picked over a two months period, the season can be extended to four with only a slight decrease in the quality of lint and a reduced viability of seed.[1]

The production of strawberries, cane, and rice are restricted to clearly defined parts of the State and during the harvest season for these crops there are not enough workers living on local farms to do the job. Likewise, if no outside labor came into some of the Delta parishes each operator, tenant, wage laborer and family laborer reported in the 1940 census would be charged under normal yields with picking an average of 9,000 pounds of seed cotton.

The assignment per worker for planting and cultivating corn and cotton runs as high as 19 acres in some parishes of the same area. At the same time these persons must also do other necessary farm work with livestock and crops. It is quite evident that non-resident labor must be used in these areas to get the work done during the peak seasons.

Total demand for 1942

Probably the best conception of the total farm labor demand for the State for 1942 can be gotten by studying Figure 1, "Louisiana Agricultural Labor Needs Estimated by Months for 1942."[1] (See also Table I

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[1] C. B. Doyle, "Climate and Cotton" *1941 Yearbook of Agriculture,* has stated that deterioration begins from three to five weeks after the opening of the bolls which in a Texas study resulted in a 4 per cent loss in grade of lint after four weeks exposure.

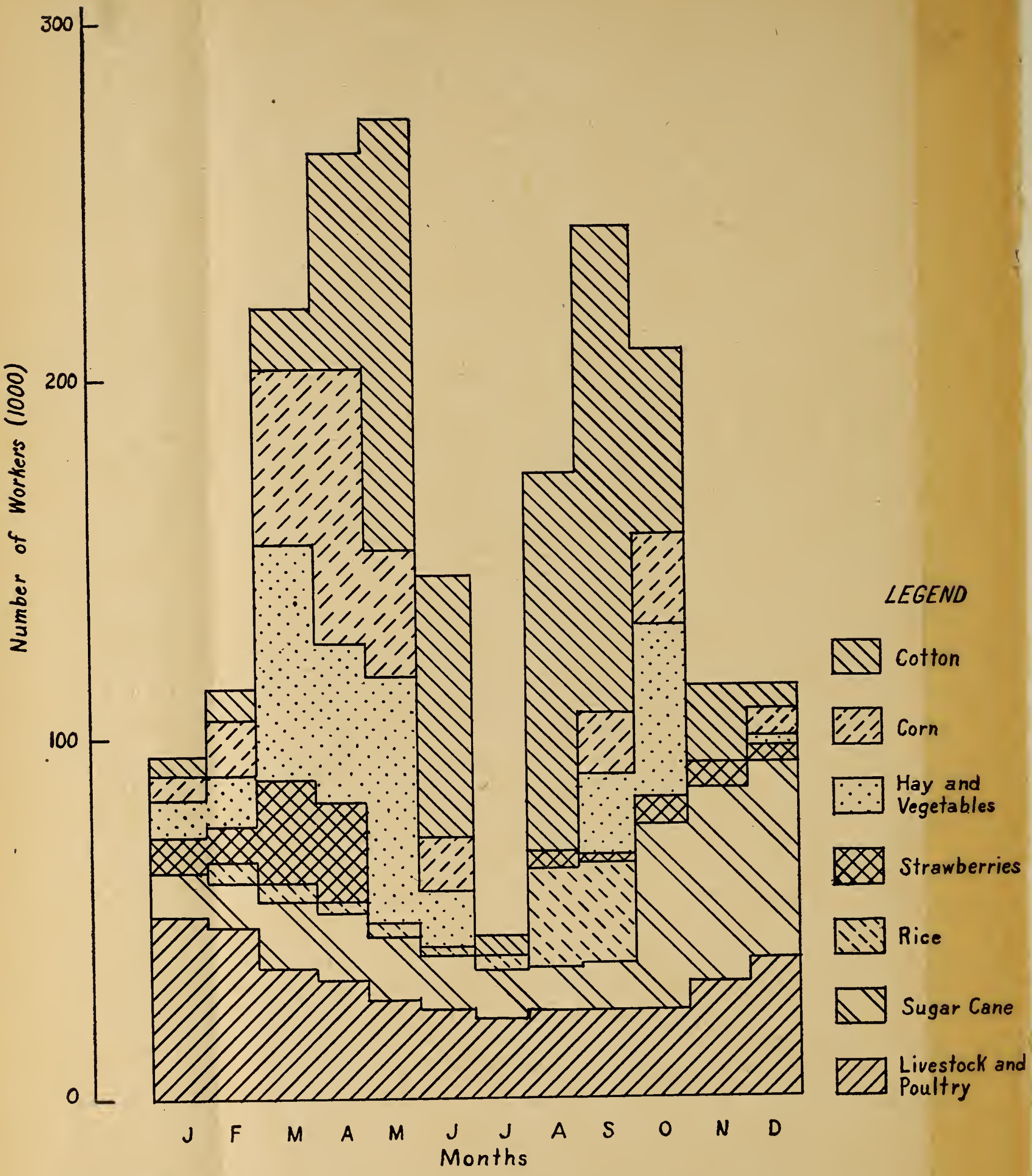

FIGURE 1. Louisiana Agricultural Labor Needs Estimated by Months for 1942.

The extreme variation shows inefficient use of manpower and makes it hard to keep laborers on the farm since most of them cannot be offered year around employment.

for details.) Several general observations may be made: (1) May is the month with greatest labor demand with an estimated need for 275,000 workers. Only a small part of this total (12,000 workers or 4 per cent) is occasioned by the food for freedom crops. (2) The next highest demands are for April with a need for 263,000 laborers and September with a need for 245,000. (3) The months of least labor demand are January and July with 93,000 and 45,000 respectively. These months have only about one-fifth of the demand in May. (4) The labor demand for the food for freedom crops is relatively more evenly distributed through the year than that for the bulk of the crops already grown. (5) The peak seasons of the various crops come at different times, thus permitting the movement of laborers between areas such as for example the sugar and rice areas.

The figures given above are based upon 22 days per month of 10 hours each for crops and 30 days per month of 10 hours each for livestock. Due to weather conditions it is usually not possible to work in the field as many as 22 days in every month. Figure 2 indicates the manpower needed in 1942 under normal and ideal weather conditions.[2]

The Supply of Farm Laborers

Efficient use of manpower

The satisfaction of the peak labor demands is obviously crucial if the production goals are to be reached. But of equal or even greater importance in the long run is the efficient use of agricultural manpower during periods of slack agricultural employment.

The number of workers available for agriculture depends upon the real need and the wage rate as compared with industrial work. Ordinarily the agricultural labor supply consists of the farm operators, their families and the wage laborers living on farms. However, if a valuable crop is in danger of being lost before it can be harvested, persons living in nearby towns and cities might well be included. During the past few years inceasing numbers of farm laborers, particularly those who furnish a great deal of the seasonal labor, have moved from the farms into villages and cities. The 1940 census shows that of those men living in urban areas roughly 4 per cent gave farming as their major occupation. Added to those are many farm workers living in villages with less than 2,500 population which the census does not count as urban. Under these circum-

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[1] The estimates given are for production of crops and livestock and do not include time spent in repairing fences, buildings, or equipment, and cleaning out ditches. Approximately 12 days each year are required to provide wood for each family's fuel needs. Work of this kind is usually done during the slack seasons so that the actual number of days work each month per person would show a slightly different distribution than that indicated by the chart.

[2] These data are based on a 5 year study for cotton and corn production in the delta area of the Mississippi. See E. L. Langsford and B. H. Thibodeaux, *Plantation Organization and Operation in the Yazoo-Mississippi Delta Area,* U.S.D.A. Tech. Bull. 682, May, 1939; p. 44, Fig. 8.

TABLE I. NUMBER OF WORKERS NEEDED BY MONTHS FOR CROP AND LIVESTOCK PRODUCTION IN LOUISIANA, 1942* (000 OMITTED)

Type of Production	January	February	March	April	May	June	July	August	September	October	November	December
All Types	93	114	220	263	275	144	45	175	245	209	114	114
Cotton	5	5	16	58	121	69	5	105	137	53	21	5
Corn	7	14	63	78	35	14	...	...	14	21	...	7
Rice	...	8	8	5	3	...	...	27	27	...	...	...
Cane	13	13	18	18	18	15	13	13	14	53	54	57
Strawberries	10	10	26	26	2	2	2	2	2	4	5	6
Vegetables and Orchards	7	17	28	31	47	16	2	3	6	21	1	1
Hay and Miscellaneous	...	...	24	14	22	3	...	...	19	32	...	...
Livestock and Poultry	51	47	37	33	27	25	23	25	25	25	33	38

*Estimates are based on average weather conditions and average yields as follows: Corn, 15 bu. per acre; Cane, 20 tons per acre; Seed cotton, 700 lbs. per acre. The acreages assumed for the principal crops are: Cotton, 1,160,000; Corn, 1,550,000; Rice, 603,000; Sugar Cane, 280,000; Strawberries, 20,000; Vegetable and Orchard, 274,000; Hay, 889,000. The number of laborers is based on a 22 day month of 10 hours each for crops and a 30 day month for livestock.

stances the farm operator is forced to recruit many of his seasonal laborers from nearby centers. But with increasing chances for full time jobs in industry, the farm laborers are becoming more difficult to get. Then too, the wage differential is against the farmer, particularly since he is not in a position to offer year around employment for all those he needs at the peak seasons. With the need for manpower in the present emergency it is obviously necessary to furnish employment for every worker as nearly 12 months in the year as possible. If this cannot be done in agriculture it is most likely that industry, particularly as accelerated in the present emergency, will continue to draw these workers from the farm.

The number of laborers available

A total of 564,000 persons over 14 years of age were enumerated in the census of April, 1940, as living on farms. Of these, 33,000 were unable to work because of old age and physical or mental handicaps. An additional 54,000 were in school and 181,000 gave their usual occupation as housewife, many of whom could be and were being utilized to a limited extent during the rush seasons. With these deductions there are left 290,000 persons capable of full time work. To carry the analysis a step further, when the estimated loss of labor to the armed forces and industry is accounted for, the labor force remaining on farms in 1942 will be approximately 165,000 men and 35,000 women or a total of 200,000. Since most of those leaving the farm are from 18 to 35 years of age, those remaining will not be capable of doing as much work as those leaving the farm.

Towns and cities supplied 14,000 wage laborers, according to the 1940 census of occupations, who gave farming as their usual occupation. It is known that many more than this number worked on farms during the rush seasons being unable to secure full employment at their place of residence. Since these workers are also relatively young and are therefore most affected by the Selective Service and the call to industry, the number available during the emergency will probably be less than half the former number.

Regardless of the theoretical supply or the actual needs, there were 470,000 persons who worked 2 or more days during the last week of September, 1939, as reported in the 1940 census. In 1942, about 23,000 more laborers will be needed and something like 130,000 of those who worked in 1939 will not be available. There is no accurate measure of how many school children over 14 years of age or housewives were included in the 470,000 so it would not be correct to say that all school children and housewives could be added to the labor force. Of the total workers there were about 224,000 family workers and the total of boys in school and all women was only 279,000. It appears that these sources of labor were being utilized in 1939 fairly well.

Summary of supply situation

1. A 5 per cent increase in labor needs takes place at the same time as an approximate loss of 25 per cent of the normal labor supply.

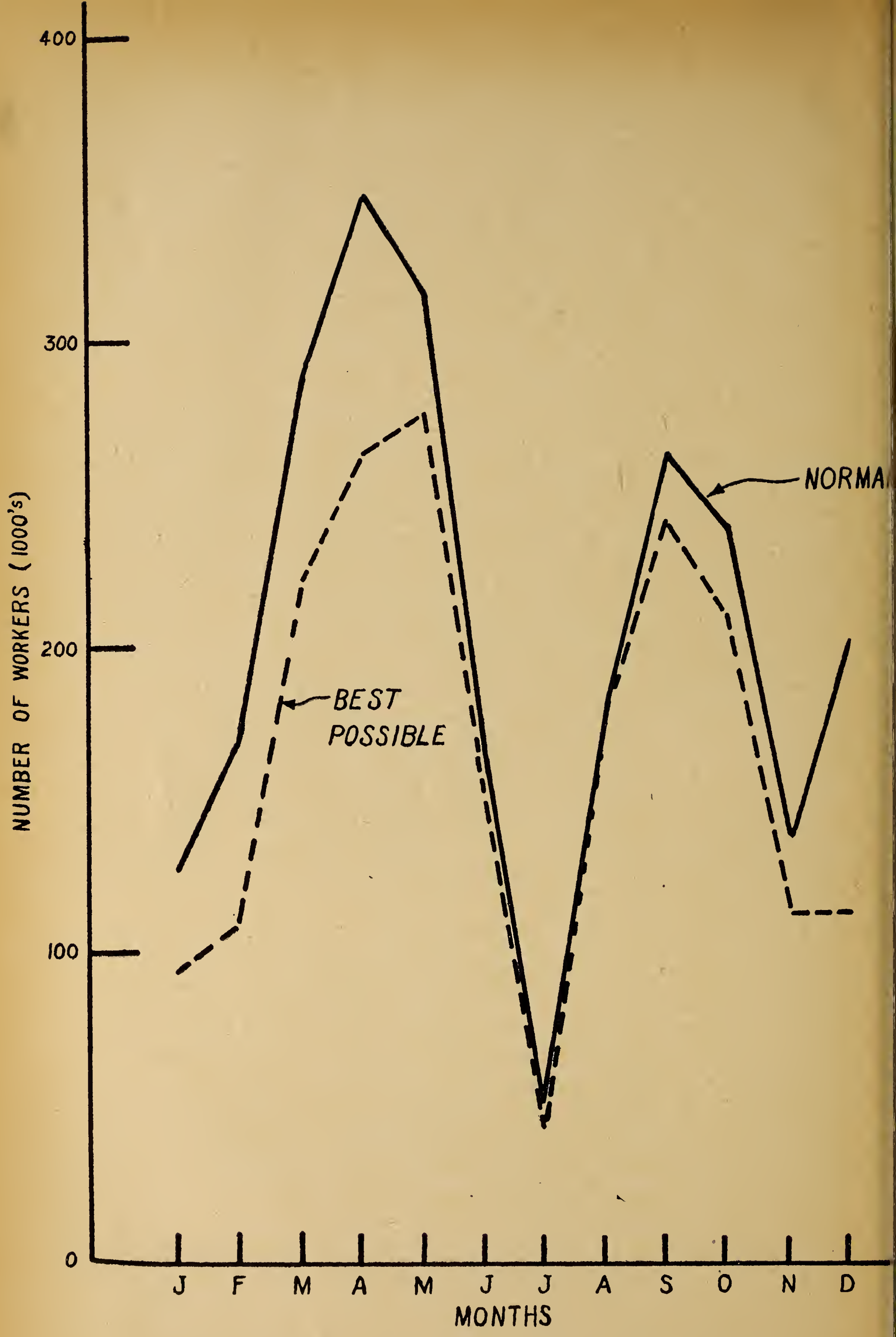

FIGURE 2. Efficiency of Manpower As Affected by Weather Conditions.

Under the best possible conditions considerably fewer workers are needed, particularly during the harvest seasons, than under average or normal conditions.

2. With "business as usual" few new individuals can be introduced into the farm labor market.
3. The solution must be a more intensive use of the normal labor force remaining.
4. Under extreme conditions all available able-bodied town and city dwellers will be needed for a short harvest season.

Special Labor Problems by Areas

For a consideration of farm labor problems the State is divided into five areas. (Figure 3) The chief factor involved in determining the areas was the relationship between the supply and demand for farm labor with various skills. To determine this relationship consideration was given to: crop and livestock combinations, the total and seasonal labor demands for each enterprise, extent of shifts in combinations of enterprises, loss of labor to the armed forces and war industries, dependency upon non-resident labor during rush seasons, managerial abilities and skills of operators and laborers as they apply to shifts in agricultural production and the opportunities for work in war industries.[1]

Plantation

Most of the workers in this area are croppers and wage laborers. If normal conditions prevail the resident workers will not be able to care for the planting and cultivating of corn and cotton nor the picking of cotton. On the other hand from October to March the labor force in the area is not used to any great extent. The Selective Service and the pull of higher wages in town will be felt less in this area than in other parts of the State because of deferments for dependents.

There has been a demand for unskilled labor in the Minden, the Alexandria and the Leesville areas but in the long run only skilled and semi-skilled workers will be desired. This area has a larger number of workers with no garden, chickens or cow which require chore work of one or two hours every day. With no chore work it is possible for these workers to go elsewhere to work. The situation of little or no work from October to March as contrasted to needs impossible to meet in April, May, September and October, will be remedied to some extent because of the increases planned for soybeans and livestock production.

Sugar and Rice

The labor needs of these two areas supplement each other in that the peak for the cane harvest immediately follows the rice harvest season. The production of rice has been increased 10 per cent which can be handled very easily except during the harvest season. The acreage in sugar cane

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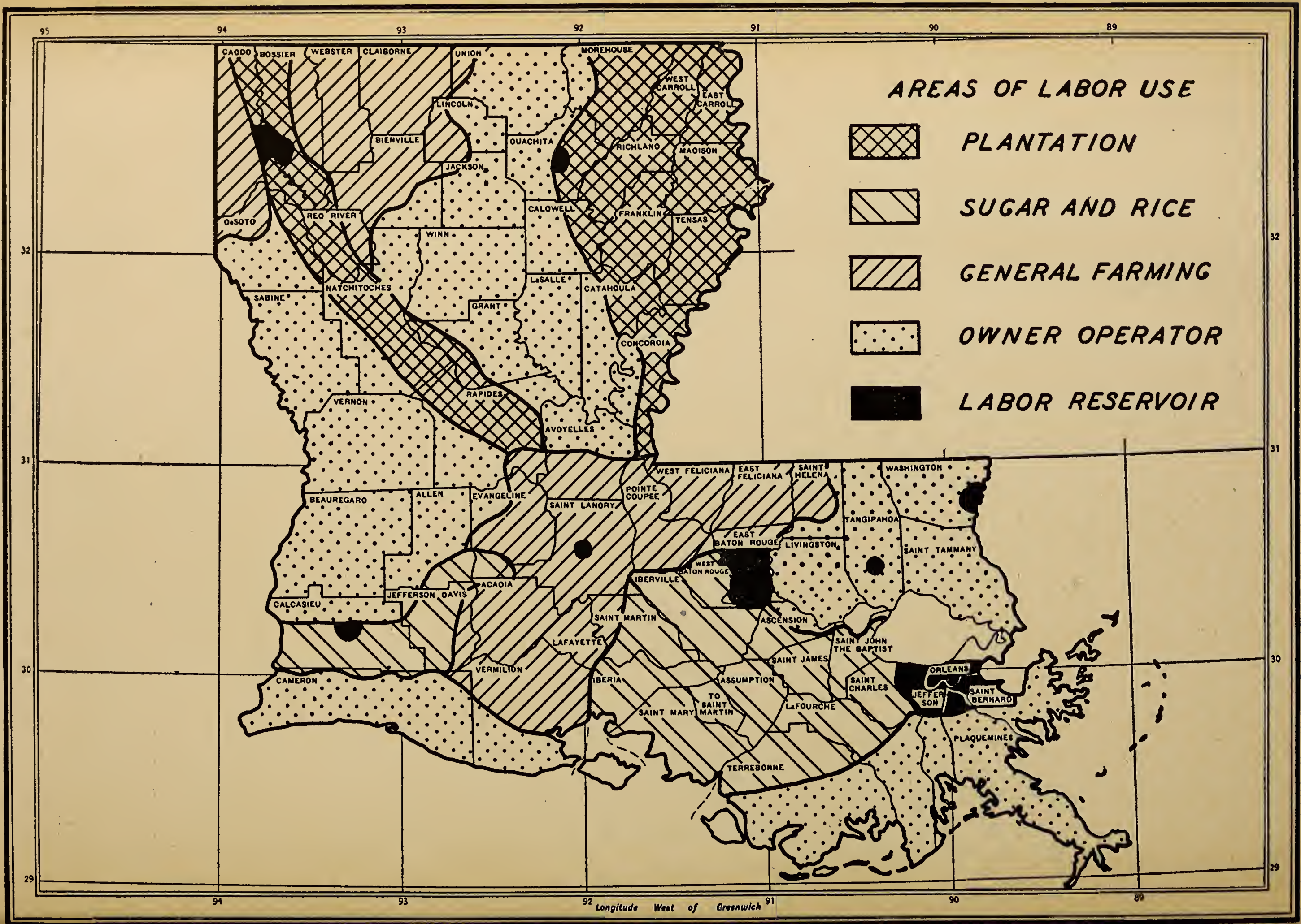
[1] This area delineation was determined to a considerable extent by previous work of the authors as reported in the publication, *Farm Tenancy in Louisiana,* Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C., 1941.


AREAS OF LABOR USE
PLANTATION
SUGAR AND RICE
GENERAL FARMING
OWNER OPERATOR
LABOR RESERVOIR
CADDO
BOSSIER
WEBSTER
CLAIBORNE
UNION
MOREHOUSE
WEST CARROLL
EAST CARROLL
LINCOLN
BIENVILLE
OUACHITA
RICHLAND
MADISON
JACKSON
DeSOTO
RED RIVER
CALDWELL
FRANKLIN
TENSAS
WINN
SABINE
NATCHITOCHES
LaSALLE
CATAHOULA
GRANT
CONCORDIA
RAPIDES
VERNON
AVOYELLES
WEST FELICIANA
EAST FELICIANA
SAINT HELENA
WASHINGTON
POINTE COUPEE
BEAUREGARD
ALLEN
EVANGELINE
SAINT LANDRY
TANGIPAHOA
EAST BATON ROUGE
LIVINGSTON
SAINT TAMMANY
WEST BATON ROUGE
IBERVILLE
ACADIA
JEFFERSON DAVIS
CALCASIEU
SAINT MARTIN
ASCENSION
SAINT JOHN THE BAPTIST
LAFAYETTE
SAINT JAMES
ORLEANS
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JEFFERSON
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Longitude West of Greenwich

for the next few years will depend upon how much sugar can be moved in from Cuba and other countries. In all probability the acreage will be increased by about 50 per cent if the emergency continues. The increase will not be particularly great during 1942, however. With normal yields and weather conditions in 1942, the Lake Charles rice area and the cane areas will be able to care for their needs because of the increase in the number of mechanical cane cutters and other machinery used in the two areas. Except for strawberry pickers, very little of the resident labor is available to go into other areas for two reasons: the labor needs of the areas are rather evenly scattered throughout the year, and both farm operators and laborers have gardens, cows and chickens which call for chore labor. Livestock is an important part of farming in the rice area and it is becoming more important in the cane area.

General Farming

Although a diversity of crops are grown and the labor needs are rather constant from month to month, and chore labor is highest for the State, this area offers the best source of farm labor for other areas of any part of the State. The effect of Selective Service and defense industries will be less than in rice, cane or upland cotton areas. Unpaid family labor is very high and farmers stay on the same farm or in the community most of their lives. These factors suggest that the people are good at farming but have had little experience or desire to work at other occupations, that they can and will work together within a family or community to conserve labor which will allow many of the workers to go to other areas during rush seasons.

Owner Operator

The farmers of this area will have greatest difficulty in meeting the production goals for which they are committed. Some of the goals are very high particularly in Vernon and Washington parishes. Selective Service will have a greater effect on the farm people of this area than any other in the State. Also unskilled work during the past few years near Alexandria, Leesville, and Minden has given farmers a taste of high cash wages. The low yield of cotton in the northwestern part of the State in 1941 sent many farmers to industrial work in the fall and winter of that year and some opportunities for unskilled labor will remain. The area around Lake Pontchartrain has become dotted with numerous small industries in the past two years. Farmers in these areas may work their own farms or work at industrial work and do some farming but an opportunity for high wages will make it difficult to get many wage workers in agriculture at less than $3.00 per day.

Labor Reservoir

The large urban centers and numerous smaller centers represent a labor reservoir for farm labor during rush seasons. Fair wages and a change of scenery will stimulate the movement of unemployed and under-employed industrial and service workers to go to the cane field, the cotton field or the berry field during the months of greatest need.

Public Agencies and Farm Labor

Several agencies have been set up which can be extremely useful to the farmer in solving his particular labor problems. It should be clear however that farm labor problems must eventually be solved by the farmers themselves. The agencies are available to assist free of charge but they cannot function properly unless individual farmers in need of labor present their problems to the agencies.[1]

United States Employment Service

A. *General purpose:* To serve all types of workers and employers by bringing the worker and the job together by the most direct route possible

B. *How it aids the farmer:* The program aims at an orderly distribution of laborers so that:

   (1) each operator will have the proper number of workers when he needs them to do his work

   (2) workers will get employment if it is available

   (3) a standardized wage rate will be established thus eliminating friction between farm operators by moving laborers on the basis of where they are needed rather than on the basis of differential wage rates

   (4) areas of shortages or oversupply of labor can be determined in advance so that the laborers can be directed accordingly.

C. *How the farm operator can use this service:*

   (1) submit a request for workers to the nearest employment office

   (2) cooperate with the farm placement supervisor from this office when he visits his farm by giving him information on:
      (a) the number of workers needed
      (b) the time required to complete the work
      (c) the rate of pay
      (d) the housing facilities available
      (e) how workers will be transported

   (3) following this, the farm operator will receive notice from the Farm Placement Supervisor that the requested number of workers, provided they are available, will be at the given location on the given day.

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[1] For a complete guide to governmental agencies see, *United States Government Manual,* Spring Issue, 1942, 698 pages. (For sale by the Superintendent of Documents, Washington, D. C., 75 cents per copy.)

D. *How the farm wage worker can use this service:*

(1) register in the nearest employment office

(2) keep in touch with office as directed so that he can be called at a later date for employment in case none is available when he registers

(3) after suitable job is found, follow instructions given by employment office as to place and time to report to work.

In case of a disagreement as to the conditions of work, both operator and workers are revisited and the situation explained so that when the workers report for work both parties are agreed as to all the conditions of work. Under the present emergency measures cooperation with the United States Employment Service is as yet voluntary for both workers and employers, but its effectiveness is obviously dependent to a considerable extent by the volume of applications which it handles. Its personnel has been greatly expanded for the emergency period to promote the war effort and it appears that only through such a labor agency can agriculture make full use of its manpower.

Work Projects Administration

Although not set up specifically as a labor agency, the work of the Work Projects Administration has a distinct relation to farm labor problems. Its general purpose is to provide work for employable persons unable to secure private employment. It aids the farmer in two ways: (1) by providing a local reservoir of labor to meet peak season demands and (2) by providing work for laborers during the slack seasons thereby increasing their yearly income and keeping them in the community for work when needed.

The farm operator can use this service by submitting his labor request to the nearest United States Employment Service office. The desired laborers, provided they are on the W.P.A. rolls, will then be released and supplied to the employer. The assignment to any given farm is handled entirely through the Employment Service and not through the W.P.A. itself. Upon satisfactory completion of such work these laborers are given priority for reemployment with the W.P.A. provided no private employment is available. It should be pointed out, however, that usually only a relatively small percentage of those on the W.P.A. rolls at any given time are farm workers; hence, the number of laborers which may be obtained from this source is likely to be small.

Farm Security Administration

The general purposes of the F.S.A. involve a number of items including assistance to low income farmers in the purchase of farms by extension of credit and supervision and the rehabilitation of farm families who are unable to secure credit elsewhere. Specifically with respect to farm labor, grants may be made to move labor from areas of oversupply to places where they are needed. In addition, permanent or mobile camps may be established, if requested by the people of a given community, to provide housing, sanitation, health, education, and recreational facilities for migratory laborers. The F.S.A. may also grant credit to operators to pay their laborers.

Individual and Community Effort

Individual effort

The first line of action in the wartime farm labor program is the individual farm, where it is essential that labor be economized as much as possible. Individual operators are in the best position to know how this can be done, but the following points are listed as suggestive:

(1) adjust farm enterprises so that agricultural workers can be used as nearly as possible 12 months in the year

(2) keep all machinery in repair so that fewer parts will be needed and less time required for repair work during the rush seasons

(3) foods raised for home use release just that much for use by the armed forces or for shipment to other countries; most of such work can be done at odd times

(4) follow closely the most efficient methods of production recommended by the extension service and the experiment station. Approved methods will yield greater returns with less effort.

Neighborhood and community effort

But in the face of the present emergency, individual effort is not enough. Cooperation between individuals is necessary. This can best take place on the basis of natural locality groups, that is, neighborhoods and communities, which are already in existence and functioning with respect to numerous services. Consciousness needs to be developed in these local groups that they may also function as agencies for handling labor needs. Possibly a given neighborhood has an oversupply of laborers or an undersupply as the case may be. This information needs to be made known on a neighborhood basis, passed on up to the next larger locality group, the community, and from thence to the parish.

But it should always be kept in mind that the problem should be handled as near as possible to the individual farm. If it cannot be solved on the individual farm, then an attempt should be made to see whether it can be handled in the neighborhood and if not in the neighborhood, then in the community, the parish, or the State. Such an arrangement will greatly facilitate the agencies already in the field which are dealing with labor problems. The United States Employment Service, for example, is anxious to move laborers no farther than is absolutely necessary. If neighborhood and community needs can be reported to them already worked out by the local citizens, the agencies' task in supplying those needs would be greatly simplified. They would not only know exactly how many laborers were needed or could be spared, but they would also know the exact locality of such need and this on the basis of information from the local citizens who are in the best possible position to know their own needs.

Although neighborhood and community action is basically sound, it does not work automatically. Local leaders are needed to carry on. The Louisiana State Agricultural Extension Service is now getting under way a plan of organization which will provide the facilities for leadership selection and neighborhood and community organization. This in turn is tied in with the United States Department of Agriculture War Boards, the Office of Civilian Defense and the various other organizations working for the war effort.

Existing organizations through which labor problems may be attacked locally

In attacking the labor problem on the neighborhood, community or other locality basis, it may be advisable to function through or in cooperation with one or more of the existing organizations. Although not designed specifically for dealing with labor problems, these groups are more or less incidentally interested in labor and could probably contribute effectively. No specific recommendation can be made for a given community since these organizations are distributed unevenly throughout the State and their effectiveness varies greatly as between different communities. The following groups, however, are among those most commonly found:

(1) Agricultural Planning Committees are set up, or probably will be in the near future, in all parishes except those around New Orleans. These committees are composed of representative farmers and the local employees of the U.S.D.A.

(2) U.S.D.A. War Boards were recently organized by Secretary of Agriculture Wickard in all parishes. The members are the chairman of the parish AAA committee and all of the paid employees of the U.S.D.A.

(3) AAA committees are organized in each parish consisting of representative farmers, the AAA Administrative Assistant and the County Agricultural Agent.

(4) Other farm organizations which usually have a paid U.S.D.A. worker as an adviser or member are as follows:

Farm Women's Clubs
4-H Clubs
Vocational Agricultural and Home Economics Adult Classes
Future Farmers and Future Homemakers of America
FSA Discussion Groups and Cooperative Organizations

Farm Bureau
Parent-Teacher Associations
Cow Testing Associations
Soil Conservation District Cooperators
Country Butchery Rings
Farm Credit Cooperatives

In summarizing the function of these organizations in dealing with labor problems it is essential to keep in mind that whatever is done by these organizations is based in the final analysis on the needs of the individual farm family living in the neighborhoods and communities of the state. The function of these organizations is to facilitate the fulfillment of the needs of these families, and thus to give the maximum aid to the war effort. Individual farmers are in a better position than anyone else to know their immediate labor needs and the satisfaction of these needs can be greatly facilitated by local cooperation in neighborhood and community groups.

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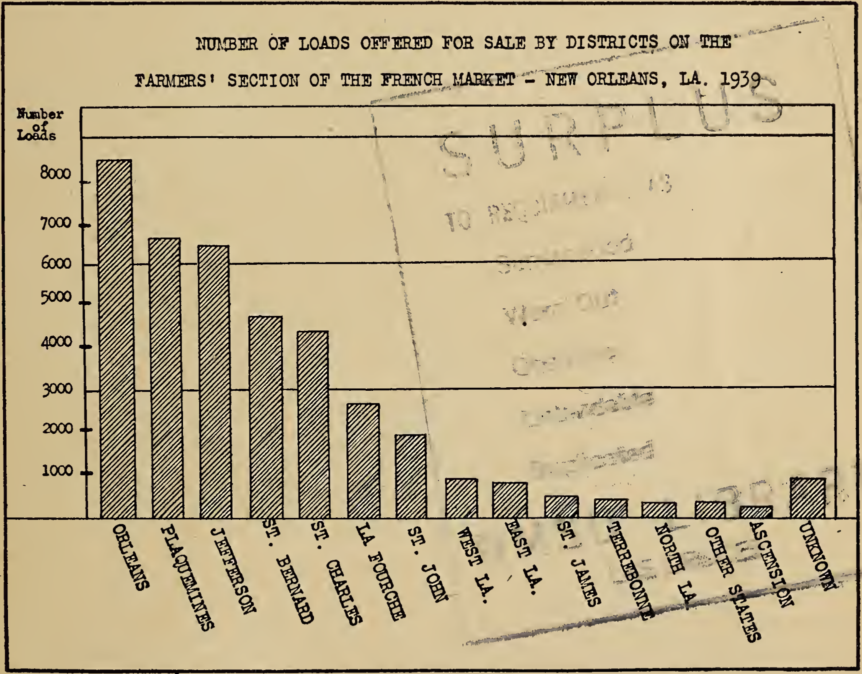
Operating Practices on the Farmers' Section of the French Market in New Orleans, Louisiana

BY

WALTER R. DANIEL AND ROY A. BALLINGER


NUMBER OF LOADS OFFERED FOR SALE BY DISTRICTS ON THE FARMERS' SECTION OF THE FRENCH MARKET - NEW ORLEANS, LA. 1939

SURPLUS

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS
W. G. TAGGART, *Director*

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Operating Practices in the Farmers' Section of the French Market in New Orleans, Louisiana[1]

By

WALTER R. DANIEL AND ROY A. BALLINGER

INTRODUCTION

The farmers' section of the French Market provides the principal outlet through which farmers producing fruits and vegetables in areas adjacent to New Orleans sell their produce in that city. The purpose of this study is to analyze the methods now being used in the marketing of these fruits and vegetables, and where possible to suggest improvements. The results of the study should be of interest to market officials and wholesale dealers in the city and surrounding territory as well as to the farmers who use the market. Consumers, who use the products which pass through the market, may also be interested in the information presented.

The data used in this study cover the operation of the farmers' section of the French Market for the calendar year 1939. Information was gathered concerning the producers registered on the market, truck-jobbers who purchased produce in the country to resell on the market, and the various types of buyers who patronized the market. Part of this information was obtained from the records of the French Market Corporation and the Federal-State Inspection Service, and part from interviews with representatives of the various types of buyers and sellers who patronized the market.

Most of the wholesale marketing of fruits and vegetables, exclusive of bananas, for the city of New Orleans and surrounding trade territory is carried on at two main centers in the city. These are the Poydras Street wholesale market and the French Market. The French Market in New Orleans is one of the oldest produce markets in the United States, which is still in operation. The market as a whole is composed of the farmers' section, wholesale sea-food establishment, retail fruit and vegetable sections, meat shops, restaurants and coffee stands. The original market structure was erected in 1791. It was destroyed by hurricane in 1812. The first of the present buildings was erected in 1813. In 1932 an extensive program of modernization and enlargement of the buildings composing the market was begun. This program has been completed and the market now has excellent physical facilities for its operation.

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[1] Mr. B. B. Jones and Mr. J. Richard Reuter of the French Market Corporation assisted the authors in planning the study and by making the records of the Corporation available for analysis.

Before the work of modernizing the buildings was started, a new arrangement for operating the market was established. Formerly the market had been under the direct control of the city government. In May 1932 a private corporation named the French Market Corporation was created, which was granted a special charter for a period of 35 years by the city government. This corporation operates the French Market. However, the corporation is not allowed to pay dividends on its common stock and its rules and regulations for the conduct of the market must be approved by the city government before they can become effective.

According to the present regulations the farmers' market is divided into two sections, the "Farmers'" and the "Truck-jobbers'." The only farmers who are permitted to sell on the market are those from Louisiana and surrounding states. Each farmer must register before offering any produce for sale. Truck-jobbers are allowed to sell only produce that has been purchased from actual farmers and grown in Louisiana. The rental for the use of a stall in selling produce is fifty cents for farmers and $1.50 for truck-jobbers per day, or the portion of a day used in selling a load.

CHARACTERISTICS OF FARMERS REGISTERED FOR USE OF THE FRENCH MARKET

At the close of 1939, the French Market Corporation had registration records from 1,776 individuals who had qualified to use the farmers' section of the market.[2] These registrations were divided into 15 groups, as shown in Table 1, according to the location of the farms. There were 16.8 per cent of the total number of registrants who had farms located in Orleans Parish. The number of registrants located in the ten parishes immediately surrounding the city of New Orleans amounted to 84.3 per cent of the total number. Only 2.3 per cent were located outside of the state of Louisiana. These figures indicate quite clearly that the business of producing supplies for the farmers' market is largely local in character. Louisiana farmers have little reason to be concerned with "Out-of-state" competition on this market.

The 1,776 registrants reported that they had a total of 66,314 acres of land in cultivation and 50,657 acres devoted to the production of fruits and vegetables. The average area per farm devoted to the production of fruits and vegetables was 28.5 acres, which was equal to slightly more than three-fourths of the total area in cultivation on these farms. As shown in Table 1 the farms in Orleans parish averaged the smallest of those in any district in Louisiana. They also had the highest percentage of their cultivated land devoted to fruits and vegetables, with the exception of St. Bernard parish.

The average size of farms was considerably influenced by the presence of a relatively few large farms. Approximately two-thirds of the farms had

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[2] These 1,776 individuals will be referred to as registrants in the following discussion.

TABLE 1. NUMBER OF REGISTRANTS, SIZE OF FARM, AND PER CENT OF CULTIVATED ACRES USED FOR THE PRODUCTION OF FRUITS AND VEGETABLES BY DISTRICTS.

District	Number of registrants	ACRES DEVOTED TO FRUITS AND VEGETABLES		Average number acres in cultivation	Per cent of cultivated acres used for fruits and vegetables
		Total	Average		
Ascension	17	823.0	48.4	118.3	40.9
Jefferson	203	4,474.5	22.0	22.9	96.1
Lafourche	216	10,168.0	47.1	72.8	64.7
Orleans	299	2,435.6	8.1	8.3	97.6
Plaquemines	278	4,822.6	17.4	19.7	88.3
St. Bernard	129	2,399.5	18.6	19.0	97.9
St. Charles	190	6,980.0	36.7	45.7	80.3
St. James	44	1,827.0	41.5	57.9	71.7
St. John	75	3,223.0	42.9	61.5	69.7
Terrebonne	47	2,978.0	63.4	74.8	84.7
North Louisiana	29	1,110.0	38.3	45.0	85.1
West Louisiana	90	4,483.0	49.9	73.2	68.2
East Louisiana	119	2,553.0	21.5	27.5	78.2
Alabama and Mississippi	33	2,011.0	6.1	7.5	81.3
Other states	7	369.0	52.7	75.6	69.7
TOTAL	1,776	50,657.2	28.5	37.3	76.4

fewer than 28.5 acres devoted to the production of fruits and vegetables, and 10 per cent had fewer than 2.5 acres. Only 5.5 per cent of the total number had more than 87.5 acres in fruits and vegetables and less than one-fourth of the registrants had more than 37.5 acres. These figures clearly indicate that the business of growing fruits and vegetables for the farmers' section of the French Market is primarily a small scale business for persons who live on small farms.

However, it appears that nearly 50 per cent of the acreage used for fruits and vegetables was double cropped. Thus 74,393 acres of various fruits and vegetables were grown on the 50,657 acres used for their production. The ten highest ranking crops according to the proportion of the total number of acres of each produced were corn 19.9 per cent, Irish potatoes 8.7 per cent, broccoli 6.4 per cent, beans 5.7 per cent, cabbage 5.4 per cent, turnips 4.8 per cent, shallots 3.7 per cent, sweet potatoes 3.7 per cent, carrots 2.3 per cent, and mustard 2.1 per cent. This is, of course, only a very rough measure of the relative importance of these crops, since some of them make much more intensive use of the land than do others. For instance corn occupies much more area per unit of value than do many other fruits and vegetables.

FARMERS' SALES ON THE MARKET

Farmers are the principal, although not the only, sellers on the farmers' section of the French Market. Information was obtained by personal interviews from 147 farmers who were using the market in 1940.

During the previous year these farmers had used the market an average of 52 times. The number of times the market had been used varied from two by one member of the group to 200 by another member. These farmers spent an average of 15 hours selling a load of produce. The market was open 17 hours per day. The extreme range in time required to sell a load was from one hour to 102 hours. In the opinion of the farmers interviewed these wide variations in the time required to sell a load were largely the result of market conditions, the commodity being sold, and the size of the load. Occasionally a load was sold almost as soon as it arrived at the market, and at other times some commodity such as Irish potatoes remained on the market a week before being disposed of. Certain perishable products obviously cannot be held in good condition on the market for more than one day.

The farmers reported that the proportion of the fruits and vegetables produced on their farms which was sold on the farmers' section of the French Market varied from one to one hundred per cent. The average was 82 per cent. Nearly 60 per cent reported selling all of their fruits and vegetables on the farmers' market. Less than 11 per cent sold as much as 50 per cent elsewhere. The number of commodities sold per farm varied from one to 40. The average was 13. Only about 10 per cent of the farms had more than 25 commodities for sale.

Value of Loads Sold

The average value of the loads sold by farmers on the French Market in 1939 was $43.20 (Table 2). The lowest value of any load reported was $2.00 and the highest $230.00. Nearly one-half of the farmers reported that their lowest receipts for any one load during the year was $10.00 or less. The maximum value for a single load varied from $80.00 to $230.00. However, the larger values were relatively uncommon.

TABLE 2. VALUE OF LOADS OFFERED FOR SALE BY PRODUCERS ON THE FARMERS' SECTION OF THE FRENCH MARKET, NEW ORLEANS, 1939.

	Lowest value reported	Average value repotred	Highest value reported
Average value of all loads sold	$ 10.00	$ 43.20	$ 125.00
Lowest value of loads sold	2.00	16.00	80.00
Highest value or loads sold	18.00	83.90	230.00
Minimum value necessary to justify trip to market	3.00	20.00	80.00

The farmers' estimates of the amount necessary to justify a trip to the market varied from $3.00 to $80.00. In general, the farmers living near the market could afford to bring a much less valuable load than could those situated at greater distances.

Time of Arrival at Market

More than 61 per cent of the farmers interviewed customarily arrived at the market by the time it opened at 3:00 A.M. Nearly 13 per cent reported that they had no special time when they planned to reach the market, but came whenever it was convenient. Also there was a slight concentration of arrivals at 2:00 P.M.

The reason given by most farmers for their time of arrival was that by reaching the market early in the morning they could obtain the benefit of the early morning market and of a full day's sales for the payment of only one rental fee. Most farmers thought that the morning market was brisker and prices better than at other times during the day. However, some farmers preferred the afternoon market and a few made a practice of arriving in the afternoon and observing the market for a while before registering. If the prospects for a satisfactory sale appeared good they registered their load for sale, otherwise they waited until the next morning before selling.

Another reason for the early morning arrival of most farmers was their desire to obtain the location they preferred on the market. Most farmers thought that their sales were better if their load was located near the center of the market. Consequently there is a good deal of competition for these locations. Early arrivals are thought to have a better chance to obtain these locations.

Government Market Reports and Inspection Service

Slightly more than one-half of the farmers reported that they were not acquainted with the fruit and vegetable market reports issued daily by the United States Department of Agriculture for the New Orleans markets. In general, most of the farmers who were acquainted with the reports were not very enthusiastic about them. There were complaints that the prices reported were inaccurate and that the range of prices given was too wide. However, about one-fifth of the farmers thought that the reports were helpful to them.

It was difficult to obtain accurate information concerning prices received by farmers to compare with the market reports. It was apparent that there was considerable variation in prices both within a single day as well as from day to day. Also there appeared to be some variation between different parts of the market at the same time. Most farmers thought prices tended to be highest in the early morning when trading was most active. However, in the opinion of some, there were too many small buyers who were looking only for bargains at this time and consequently prices were likely to be higher in the afternoons.

A Federal-State inspection service is maintained in New Orleans for the purpose of examining fruits and vegetables and certifying to the grade of various lots. The rules of the French Market require that potatoes, onions and citrus fruits be inspected before they are offered for sale. Farmers are charged a small fee for this inspection. Farmers may have other products inspected if they wish. About one-fourth of the farmers interviewed stated that they thought that the inspection service was profitable to them, one-tenth thought that it was not. The remainder did not appear to have any definite opinion. Practically no use was made of the inspection service, except when it was mandatory. Most of the farmers thought that the market did not offer sufficient premiums for quality products to justify the expense of inspection. In most cases, even where inspection was mandatory, the buyers examined the produce and bought on the basis of their own inspection rather than on the inspector's grade.

Type of Buyer Preferred

There are five distinct classes of buyers who operate on the farmers' section of the French Market. They are consumers, independent storekeepers, peddlers, chain stores, and truckers. An estimate of the proportionate volumes sold by farmers to each type of buyer is shown in Table 3. In some cases the farmers did not know the kind of buyer to whom they were selling. However, the averages given probably are approximately correct.

TABLE 3. PERCENTAGE OF PRODUCE SOLD TO DIFFERENT TYPES OF BUYERS ON THE FARMERS' SECTION OF THE FRENCH MARKET, AS REPORTED BY 106 FARMERS, NEW ORLEANS, 1939.

Type of buyer	PER CENT OF PRODUCE SOLD		
	Average of 106 farmers	Lowest percentage sold	Highest percentage sold
Consumers	0.9	0.0	25.0
Independent stores	34.3	0.0	80.0
Peddlers	24.3	0.0	80.0
Chain stores	9.1	0.0	75.0
Truckers	30.4	0.0	75.0
Other buyers	0.5	0.0	10.0

From the farmers' point of view, each type of buyer possessed certain important characteristics which distinguished him from other types. Most farmers believed that the outside truckers usually paid the best prices for produce, when they were in the market. However, truckers were not in the market regularly and at times required better quality produce than did the local buyers. These truckers were credited with removing much produce from the local consumption area and thereby helping the farmers to obtain a better price for the remainder. The consumers usually paid fair prices, but sorted the farmers' products very closely for quality and purchased only a very small volume.

The peddlers bought a large volume consistently throughout the season. They nearly always purchased the poorer qualities of produce or watched carefully for bargains. The farmers reported that some peddlers had a habit of going from one end of the market to the other saying that various items could be purchased at lower prices in other sections of the market or from wholesale dealers, in an effort to reduce prices. However, peddlers provided the briskest market in the early morning and in the late afternoon.

Most farmers considered chain stores good customers. Such stores usually purchased in large quantities, but at slightly lower prices than other buyers paid. They are rather particular about the quality of the produce they buy, and they frequently buy from regular customers by agreement. The local buyers or grocers were reported to be the most dependable purchasers in the market. They generally paid good prices and the total volume taken was large in spite of the fact that the individual sales were usually rather small.

Suggestions for Improving the Market

The farmers interviewed made numerous and various suggestions as to how the market could be improved. The most common suggestion was that the market be kept open 24 hours per day. In some cases this suggestion appeared to be motivated by the fact that wholesale fruit and vegetable dealers, located in the vicinity of the market frequently remained open during hours when the farmers' market was closed. Some farmers thought that they lost occasional sales, especially to out of town truckers, because of that fact. It was not feasible to determine the extent to which this was true. However, it would obviously add to the expense of operating the market to keep it open continuously. Also, it probably would prove inconvenient to many farmers who would feel obligated to remain on the market longer hours than they now do, without being able to increase their total sales by doing so.

Another fairly common suggestion was that price cutting on the market be stopped. None of the individuals making this suggestion appeared to have any plan for putting it into effect, although most of them seemed to think that it could be done quite easily. A few farmers even suggested that the government set the prices and make them high. When asked about the probable accumulation of a surplus if this procedure was followed, the answer was that the consumer would buy just as much at a high as at a low price. However, only a relatively small proportion of the farmers interviewed advanced this fallacious idea.

Another suggestion made by some farmers was that the fee charged for occupying a stall be assessed on a per load basis rather than a per day basis as is now done. This would obviously benefit those who remain on the market longer than one day with a single load. However, it would decrease the revenue available for operating the market. It might also encourage some farmers to remain on the market longer than they otherwise would, and occupy valuable space which other farmers needed.

TRUCK-JOBBERS' SALES ON THE MARKET

The name "Truck-jobber" was first recognized in the rules of the French Market Corporation in June, 1940. It applies to persons who purchase Louisiana farm products directly from Louisiana farmers and offer it for sale on a special section of the market. Truck-jobbers pay a rental fee of $1.50 per day instead of $.50 as paid by farmers.

The 21 truck-jobbers interviewed indicated that they used the market an average of 38 times during 1939. This number varied from 3 to 200. The time which they used to purchase products from farmers varied from 1.5 to 10 hours per load. The average number of farms from which produce was purchased was 4.9 per load. It varied from 2 to 14.

Only about one-half of the truck-jobbers indicated that they were familiar with the market reports of the Federal Government covering the New Orleans fruit and vegetable trade. This is about the same proportion as was found among the farmers. Likewise a majority of those who were familiar with these reports did not consider them very useful. Several claimed that they were unreliable.

The value of the loads offered for sale by the truck-jobbers was highly variable. As shown in Table 4, the average value of all loads was $83.30. This varied from $10.00 to $250.00. The average value was nearly twice as large as it was for farmers. However, the highest value did not vary greatly from the figure reported by farmers.

TABLE 4. Value of Loads of Produce Sold on the Farmers' Section of the French Market as Reported by Twenty-one Truck-jobbers, New Orleans, 1939.

	Value of loads		
	Lowest	Average	Highest
Average value of all loads	$ 20.00	$ 83.30	$ 135.00
Minimum value of loads	10.00	31.00	60.00
Maximum value of loads	30.00	168.30	250.00

There was a noticeable tendency for truck-jobbers to concentrate more on staple products, than was true of the farmers. Potatoes and garlic were handled more frequently than any other crop.

OPERATIONS OF BUYERS ON THE MARKET

The buyers who use the market as a source from which to obtain supplies can be conveniently divided into five classes. These are independent retailers, peddlers, wholesale dealers, chain stores, and truckers. All but the last of these classes are local buyers, who dispose of their purchases in or near New Orleans. Truckers customarily operate between New Orleans and more distant markets. Wholesalers used the market only occasionally to supplement their other sources of supply. All of the other classes of buyers were regular patrons of the market.

The average volume of business transacted per day on the market varied greatly between classes of buyers, as is shown in Table 5. The

TABLE 5. COMPARISON OF CERTAIN MARKETING ACTIVITIES OF BUYERS ON THE FARMERS' SECTION OF THE FRENCH MARKET, NEW ORLEANS, 1939.

Type of buyer	Number interviewed	Average value of loads purchased	Per cent of No. 1 quality produce attempted to buy	Per cent of fruits and vegetables bought on market	GRADING SATISFACTORY	
					Yes	No
Independent retailers	18	$ 17.36	89.4	71.1	7	11
Peddlers	10	7.55	67.2	93.5	0	10
Wholesalers	4	43.00	100.0	16.3	3	1
Chain stores	3	425.00	100.0	42.0	3	0
Truckers	28	184.46	100.0	68.2	13	15

average value of the loads purchased varied from $7.55 for the peddlers to $425.00 for chain stores. Of course there were wide variations in the amounts purchased by different representatives of each class of buyers. For instance, the average value of loads purchased by individual truckers varied from $76.00 to $376.32, while the highest value reported for a single load was $1,000.00.

Wholesalers, chain stores and truckers all reported that they attempted to purchase nothing but produce of No. 1 quality, although it was not always available on the market in sufficient quantities for their needs. The independent retailers wished to supply about 10 per cent of their needs with produce not of No. 1 quality, while the peddlers were willing to use second quality produce to the extent of about one-third of their purchases. Of course the buyers' opinions of quality probably differed considerably from those of either the farmers or Federal-State inspectors.

Independent retailers, peddlers, and truckers purchased from two-thirds to more than 90 per cent of their supply of fruits and vegetables on the farmers' section of the French Market. For many peddlers this market was practically the only source of supply. Truckers varied greatly in the extent to which they relied on the farmers' market. Some truckers purchased their entire loads there, while others used it for only a minor share of their supplies. All of the larger chains of grocery stores used the market regularly but still did not purchase as large a proportion of their fruits and vegetables there as did the independent retailers.

During the course of the year 92 different products were offered for sale on the market. Many of the buyers purchased a wide selection from these, although none used all of them. The commodities most commonly purchased by buyers were snap beans, turnips, Irish potatoes, cabbage, and mustard. There was little difference between the various types of buyers in the relative importance of the principal commodities purchased. In all cases the staple, rather than the more perishable commodities, made up the bulk of the products handled.

Somewhat more than one-half of the buyers interviewed had some complaint regarding the grading and sorting of produce on the market. In some cases it was stated that the quality was not always uniform throughout packages of produce. Other buyers had difficulty getting the quality desired of certain commodities. Some of the buyers suggested that the farmers should guarantee the grade of the produce they sold and assume responsibility if the grade was not as represented. Since the buyers always have an opportunity to inspect produce before buying it, the necessity for such an arrangement appears doubtful.

The buyers were substantially in agreement with the farmers and truck-jobbers in believing that price fluctuations on the market were both too frequent and too great. However, they offered no feasible plans for improving the situation. None of the buyers seemed to think that the market news service of the Federal government was of much importance in this connection, and only about one-half of the buyers claimed to be acquainted with the reports issued.

VOLUME OF PRODUCE HANDLED

The volume of produce handled on the market can be measured in two ways. One is by the number of loads that were registered for sale, the other by the number of units of each commodity brought to the market. A load is a very rough measure of volume, but it is a unit common to all commodities so that by using it some idea of the total volume of produce on the market can be obtained.

The number of loads registered on each market day during the year 1939 is shown in Table 6. The total number of loads for the entire year was 45,453, or an average of 173 loads per market day. The market provides stalls for approximately 200 loads of produce at one time. There were 76 days during the year when more than 200 loads registered. The maximum number of loads during the year was 376 on June 16. Ordinarily the market can take care of more loads in one day than there are stalls because many loads remain on the market only a short time and two or more loads can use the same stall during a single day. During the summer months of May, June and July, when the market was most active, 35 per cent of the year's total number of loads were offered for sale, while in the fall months of September, October and November only 19 per cent were present.

During the year 1939 there were 1,815 different individuals who sold produce on the market. Table 7 shows the number of individuals who used the market varying numbers of times during each month of the year. For instance 158 individuals used the market one time in January and 16 used it more than 20 times. For the entire year there were 202 persons, or 11 per cent of the total, who used the market only once, while 652 persons, amounting to 36 per cent of the total, used the market more than 20 times. There were 71 individuals who offered produce for sale more than 100 times during the year. It is apparent that most of the farmers who sold produce on the market did so only occasionally, while a comparatively small number patronized the services of the market rather frequently. Some farmers who produced only one or two crops suitable for

TABLE 6. NUMBER OF LOADS REGISTERED ON THE FARMERS' SECTION OF THE FRENCH MARKET ON EACH MARKET DAY DURING THE YEAR 1939. (HOLD-OVERS AND NEW ARRIVALS)

Day of the month	MONTH											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		182	161		232	217		168	169		26	167
2		179	163		198	299		130		130	163	
3	210	195	137	165	193		236	173		118	165	
4	191			167	200			239	152	105		152
5	208			212	233	300	253		150	121		120
6	211	185	179	177		271	240		130	169	147	137
7		157	155	71		226	289	211	137		118	140
8		176	150		240	227		161	154		109	140
9	(183	175	136		214	335		148	4	135	135	
10	164	193	166	117	218		217	137		120	132	
11	195	1	3	127	227		163	230	117	125		153
12	167			168	249	297	220		102	144		157
13	208	205	175	187		226	225		114	187	125	174
14		199	122	199		231	280	135	116		147	154
15		125	159		265	230		146	164		135	195
16	179	160	162		235	376		133	2	132	138	
17	181	190	186	193	196		231	158		117	120	
18	188	1		168	199		212	205	120	104		171
19	170			200	265	281	183		101	127		157
20	199	168	135	205		261	203		89	212	174	148
21			127	208		232	264	166	69		185	159
22		148	144		298	262		131	157		120	213
23	192	128	149		280	281		127		155	2	1
24	147	230	190	162	276		202	118		141	158	
25	132			166	204		177	206	121	149		
26	190			209	298	289	183		116	177		41
27	163	179	166	211		234	187		117	220	158	94
28		122	143	248		237	241	111	146		147	169
29			167		308	243		96	180		139	240
30	172		164		250	293		105		192	121	
31	141		190		237		187	138		94		
Average.......	181	157	151	178	240	266	220	155	119	144	130	147

sale on the market were regular patrons during the marketing season for those crops, but made no use of the market during the remainder of the year. A few farmers produced a wide enough variety of crops to enable them to patronize the market throughout the year.

The loads of produce registered for sale are divided into two general classes on the records of the French Market Corporation. These are called new-arrivals and hold-overs. A "new-arrival" is a load which is registered for sale for the first time. In case a load is not completely sold on the day when it is first registered the owner may keep the load on the market for one or more additional days. When this is done the load must be re-registered each day. Such loads are called "hold-overs."

The number of registrants and the number of loads of each type coming from various parishes and districts is shown in Table 8. A smaller proportion of the registrants than of the number of loads registered for

TABLE 7. NUMBER OF INDIVIDUALS WHO REGISTERED LOADS OF PRODUCE FOR SALE DIFFERENT NUMBER OF TIMES ON THE FARMERS' SECTION OF THE FRENCH MARKET, NEW ORLEANS, 1939.

Number of times registered	NUMBER OF INDIVIDUALS												
	MONTH												
	January	February	March	April	May	June	July	August	September	October	November	December	Annually
1	158	116	117	179	181	192	171	189	194	203	172	139	202
2	74	86	90	115	135	118	119	129	105	117	91	78	164
3	59	71	60	103	85	78	91	97	62	78	76	49	102
4	48	67	50	95	78	65	92	71	71	66	42	41	88
5	42	49	49	79	77	73	57	54	53	36	46	39	80
6	35	36	44	58	54	60	46	37	30	37	33	30	61
7	33	32	30	34	49	55	41	41	31	36	34	32	51
8	26	33	26	32	50	45	35	23	23	28	18	25	52
9	34	32	21	21	49	38	20	28	30	18	11	17	42
10	20	16	23	21	36	23	29	24	20	19	15	18	27
11	14	15	18	9	25	31	22	12	6	14	12	17	33
12	19	14	19	13	19	20	24	12	5	9	11	18	35
13	14	7	14	6	22	23	9	4	8	11	5	11	31
14	15	0	10	9	19	22	14	7	2	6	7	6	33
15	11	6	6	3	12	17	4	2	5	8	6	10	25
16	7	1	7	4	8	15	10	12	3	3	7	5	38
17	13	1	3	0	9	8	5	4	3	8	8	6	22
18	5	2	6	2	7	10	5	2	2	1	4	2	25
19	3	0	4	1	4	10	2	0	0	4	1	2	28
20	6	1	4	1	3	5	3	4	0	1	2	1	24
Over 20	16	6	12	3	15	19	11	2	2	4	6	9	652
TOTAL	652	592	614	790	940	921	810	745	655	707	607	556	1,815

sale came from Orleans and adjoining parishes. Apparently the nearby growers patronized the market more frequently than did those from a greater distance. Also the distribution of new-arrival loads was quite different than that of the hold-overs. For instance, Orleans parish supplied 21 per cent of the new-arrivals but sold about 4 per cent of the hold-overs, while Plaquemines parish with less than 17 per cent of the new-arrivals had 28 per cent of the hold-overs. Obviously certain of the more perishable products cannot be held on the market for more than one day, while certain staple articles such as oranges and potatoes can be held for a week or more. The parishes with the highest proportion of hold-over loads were those in which these more staple commodities were produced.

TABLE 8. NUMBER AND PER CENT OF REGISTRANTS AND OF LOADS REGISTERED ON THE FARMERS' SECTION OF THE FRENCH MARKET BY TYPE OF LOAD AND PLACE OF ORIGIN, NEW ORLEANS, 1939.

Place of origin	REGISTRANTS		LOADS OF PRODUCE					
			NEW ARRIVALS		HOLD-OVERS		TOTAL	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Unknown			660	1.6	6	.1	666	1.5
Ascension	17	.9	111	.3	17	.3	128	.3
Jefferson	203	11.4	6596	16.5	419	7.8	7015	15.2
Lafourche	216	12.2	2774	6.9	1109	20.6	3883	8.5
Orleans	299	16.8	8531	21.3	213	3.9	8744	19.0
Plaquemines	278	15.7	6638	16.6	1518	28.1	8516	18.6
St. Bernard	129	7.3	4803	12.0	150	2.8	4953	10.9
St. Charles	190	10.7	4416	11.0	629	11.7	5045	11.0
St. James	44	2.5	613	1.5	131	2.4	744	1.6
St. John	75	4.2	1937	4.8	241	4.5	2178	4.8
Terrebonne	47	2.6	471	1.2	204	3.8	675	1.5
North Louisiana	29	1.6	210	.5	20	.4	230	.5
West Louisiana	90	5.1	1070	2.7	493	9.1	1563	3.4
East Louisiana	119	6.7	1033	2.6	199	3.1	1232	2.7
Alabama and Mississippi	33	1.9	186	.5	45	.8	231	.5
Other states	7	.4	8	*	2	*	10	*
TOTAL	1776	100.0	40,057	100.0	5396	100.0	45,453	100.0

*Less than 0.05 per cent.

The loads offered for sale on the market contained from one to nine different commodities. The average number of commodities per new-arrival load was approximately two, and per hold-over one and one-half. Nearly one-half of the new-arrival loads contained only one commodity and only 0.3 per cent had seven or more commodities. Only 39 per cent of the hold-over loads contained more than one commodity. The average number of commodities in loads from Orleans and other near-by parishes was larger than it was in the more distant sections. Producers from the areas further removed from the market tended to specialize on one or two commodities to a greater extent than did those located near New Orleans.

A total of 92 different commodities was offered for sale on the market at some time during the year 1939. A few of these commodities appeared only rarely during the year, while others were present nearly every day. Table 9 shows the number of units of each of these commodities which were offered for sale in 1939. There were only 3 gallons of wild cherries, but 252,597 dozen bunches of carrots.

Perhaps a better idea of the relative importance of each commodity can be obtained from the number of loads containing each one. For instance 5,308 new-arrival loads contained spinach or 13.3 per cent of the total number of such loads. However, only 3.8 per cent of the hold-over loads had this commodity for sale. The only commodities which were present in 10 per cent or more of the new arrival loads were snap beans, beets, cabbage, carrots, parsley, spinach, and turnips. There were 25 commodities which were present in less than 0.05 per cent of the loads. Only sweet oranges and Irish potatoes were present in as many as 10 per cent of the hold-over loads. There were 26 commodities which were not represented at all in hold-over loads and 10 which were present in less than 0.05 per cent of the loads.

The seasonal changes in volume offered for sale on the market were, of course, quite different for different commodities because of the varying dates of maturity for the different crops. Only 17 of the 92 commodities were offered for sale during each of the twelve months. There were three which appeared during eleven months. At the other extreme were six commodities which were offered for sale during only one month and five during two months.

The largest number of commodities offered for sale during any month was 66 in May. There were 64 different products on the market in June. The smallest number of commodities was offered for sale in March and April, when 47 and 48 products respectively were present. The average number of commodities per month for the entire year was 56. The New Orleans market is much more stable with respect to seasonal variations in volume than are most other similar markets in the United States. This relative stability apparently results from the wide variety of produce coming to market, which allows for considerable shifting of commodities, but maintains the total volume coming to market at a relatively stable figure.

There were wide variations in the proportions of the various commodities coming from different sections of the state. The per cent of each commodity originating in each section is shown in Table 10. West Louisiana, for instance, furnished 80.5 per cent of all the sweet potatoes on the market. Plaquemines parish supplied 95.9 and 91.2 per cent respectively of the sweet and navel oranges on the market. North Louisiana supplied 55.0 per cent of the watermelons on the market but very few other products. The most important product coming from east Louisiana was straw-

TABLE 9. Summary of Market Offerings by Type of Load and by Commodities, Showing the Number of Units and the Number of Loads for Each Commodity Offered for Sale on the Farmers' Section of the French Market, New Orleans, 1939.

Commodity	Unit of measure	New arrivals			Hold-overs		
		Number of units	Loads		Number of units	Loads	
			Number	Per cent		Number	Per cent
Anise	Doz. Bun.	7,777	362	0.9	84	7	0.1
Apples	Bu.-Ham.	285	4	*	35	1	*
Artichokes	Bu.	25	2	*	0	0	0.0
Bay leaf	Doz. Bun.	1,016	125	0.3	40	2	*
Beans, fava	Bu.-Ham.	5,691	515	1.3	295	25	0.5
Beans, lima	Bu.-Ham.	29,216	3,285	8.2	1,489	118	2.2
Beans, snap	Bu.-Ham.	93,896	5,195	12.9	6,365	327	6.1
Beets	Doz. Bun.	130,928	4,000	10.0	6,252	194	3.6
Beets (topped)	100-lb. sack	27	6	*	0	0	0.0
Blackberries	Gallon	631	194	0.5	32	1	*
Broccoli	Doz. Bun.	27,771	1,886	4.7	1,298	58	1.1
Cabbage	Head	332,818	4,056	10.0	39,428	509	9.4
Cantaloupes	Each	50,407	126	0.3	6,720	28	0.5
Carrots	Doz. Bun.	252,597	4,826	12.1	13,513	283	5.3
Carrots (loose)	Sacks	1,775	121	0.3	159	5	0.1
Cardonas	Doz. Bun.	1,892	62	0.2	95	2	*
Cauliflower	Doz. Head	24,321	500	1.2	2,540	58	1.1
Celery	Bu. Bskt.	103	16	*	0	0	0.0
Celery	Doz. Bun.	6,793	222	0.6	0	0	0.0
Cherries, wild	Gallon	3	1	*	0	0	0.0
Chives	Hamper	201	31	0.1	0	0	0.0
Chicory	Doz. Bun.	582	74	0.2	0	0	0.0
Cocozon	Doz	1,072	89	0.2	0	0	0.0
Collards	Doz. Bun.	71,928	2,552	6.4	2,283	71	1.3
Cumquats	Bu.-Ham.	295	30	0.1	8,004	3	0.1

*Less than 0.05 per cent.

TABLE 9. SUMMARY OF MARKET OFFERINGS BY TYPE OF LOAD AND BY COMMODITIES, SHOWING THE NUMBER OF UNITS AND THE NUMBER OF LOADS FOR EACH COMMODITY OFFERED FOR SALE ON THE FARMERS' SECTION OF THE FRENCH MARKET, NEW ORLEANS, 1939—Continued

Commodity	Unit of measure	NEW ARRIVALS			HOLD-OVERS		
		Number of units	LOADS		Number of units	LOADS	
			Number	Per cent		Number	Per cent
Corn	Ear	808,001	2,692	6.7	85,173	330	6.1
Cowpeas	Doz.	16,046	868	2.2	515	23	0.4
Cucumber	Bu.-Ham.	29,118	1,238	3.1	4,304	172	3.2
Easter lily plants	Each	1,080	5	*	200	1	*
Eggs	Doz.	343	30	0.1	0	0	0.0
Eggplant	Doz	104,392	1,701	4.3	6,624	89	1.6
Endive	Hamper	3,085	388	1.0	17	3	0.1
Escarole	Hamper	3,072	408	1.0	1	1	*
Figs	Pound	8,776	140	0.4	52	3	0.1
File	Bottles	30	1	*	0	0	0.0
Flowers	Doz.	110	12	*	0	0	0.0
Garlic	100-lb. sacks	3,353	116	0.3	693	53	1.0
Garlic	Strings	21,076	335	0.8	5,869	107	2.0
Goatbeans	Doz Bun.	287	5	*	0	0	0.0
Grapefruit	Bu.-Ham.	3,213	262	0.7	628	82	1.5
Kale	Doz. Bun.	37	8	*	0	0	0.0
Kohlrabi	Doz. Bun.	1,268	124	0.3	0	0	0.0
Leek	Doz. Bun.	8,344	883	2.2	45	7	0.1
Lemons	Doz.	55	5	*	0	0	0.0
Lettuce	Head	103,437	1,237	3.1	17,149	184	3.4
Manderines	Bushel	22,237	583	1.5	6,607	288	5.3
Mint	Doz. Bun.	5	2	*	0	0	0.0
Mushrooms	Bucket	12	5	*	0	0	0.0
Mustard	Doz. Bun.	98,548	3,062	7.7	3,978	116	2.2
Okra	Bu. Ham.	40,820	3,850	9.6	1,583	124	2.3

*Less than 0.05 per cent.

TABLE 9. SUMMARY OF MARKET OFFERINGS BY TYPE OF LOAD AND BY COMMODITIES, SHOWING THE NUMBER OF UNITS AND THE NUMBER OF LOADS FOR EACH COMMODITY OFFERED FOR SALE ON THE FARMERS' SECTION OF THE FRENCH MARKET, NEW ORLEANS, 1939—Continued

Commodity	Unit of measure	NEW ARRIVALS			HOLD-OVERS		
		Number of units	LOADS		Number of units	LOADS	
			Number	Per cent		Number	Per cent
Onions, dry	50-lb. sacks	39,759	829	2.1	22,278	431	8.0
Onions, green	Doz. Bun.	21,580	311	0.8	4,540	65	1.2
Oranges, sweet	Bu.-Ham.	111,887	1,507	3.7	38,071	834	15.5
Oranges, naval	Bu.-Ham.	19,720	602	1.5	3,626	211	3.9
Parsley	Doz. Bun.	128,337	4,684	11.7	3,910	162	3.0
Peaches	Bushel	113	3	*	0	0	0.0
Peas, field	Bu.-Ham.	4,024	293	0.7	312	19	0.4
Peas, English	Bu.-Ham.	3,935	314	0.8	515	32	0.6
Pecans	Cwt.	1,370	45	0.1	943	17	0.3
Pears	Bu.-Ham.	11,798	354	0.9	1,272	45	0.8
Pepper, sweet	Bu.-Ham.	27,298	1,423	3.6	3,527	124	2.3
Pepper, hot	Bu.-Ham.	470	60	0.1	5	1	*
Persimmons	Bu.-Ham.	103	12	*	6	1	*
Pigs	Each	92	5	*	0	0	0.0
Plums	Bu.-Ham.	10	5	*	0	0	0.0
Potatoes, Irish	Cwt.	97,379	2,130	5.3	38,913	1,011	18.8
Potatoes, sweet	Cwt.	75,051	944	2.4	25,542	438	8.0
Poke salad	Doz. Bun.	16	1	*	0	0	0.0
Pomegranates	Doz.	36	1	*	0	0	0.0
Pumpkins	Each	71,389	429	1.1	15,264	87	1.6
Radish	Doz. Bun.	13,245	982	2.5	302	19	0.4
Rice	Pound	1,500	1	*	0	0	0.0
Satsuma	Bu.-Ham.	20,141	419	1.0	5,761	169	3.1
Shallots, dry	Pound	10,119	18	*	2,162	5	0.1
Shallots, green	Pound	132,910	3,076	7.7	6,610	171	3.2

*Less than 0.05 per cent.

TABLE 9. SUMMARY OF MARKET OFFERINGS BY TYPE OF LOAD AND BY COMMODITIES, SHOWING THE NUMBER OF UNITS AND THE NUMBER OF LOADS FOR EACH COMMODITY OFFERED FOR SALE ON THE FARMERS' SECTION OF THE FRENCH MARKET, NEW ORLEANS, 1939—Continued

Commodity	Unit of measure	NEW ARRIVALS			HOLD-OVERS		
		Number of units	LOADS		Number of units	LOADS	
			Number	Per cent		Number	Per cent
Snowball man	No unit	162	74	0.2	0	0	0.0
Spinach	Doz. Bun.	213,631	5,308	13.3	8,406	203	3.8
Spinach (wh. leaf)	Doz. Bun.	11,097	346	0.9	62	4	0.1
Squash (long)	Doz.	1,068	105	0.3	35	4	0.1
Squash	Bu.-Ham.	30,473	1,586	4.0	2,120	136	2.5
Strawberries	Crates	1,618	48	0.1	145	8	0.1
Sugar Cane	Doz. Stalks.	768	46	0.1	41	4	0.1
Syrup	Gallon	360	7	*	0	0	0.0
Tangerine	Bu.-Ham.	19,202	532	1.3	5,280	223	4.1
Thyme	Doz. Bun.	10,583	792	2.0	573	49	0.9
Tinerones	Doz. Bun.	163	26	*	0	0	0.0
Tomatoes	Half Bu. box	89,114	2,605	6.5	4,678	122	2.3
Turnips	Doz. Bun.	288,349	4,939	12.2	17,264	314	5.8
Turnip greens	Doz. Bun.	389	7	*	203	2	*
Turnips (topped)	Cwt.	660	14	*	23	2	*
Vegetable pears	Doz.	3,827	195	0.5	25	4	0.1
Watermelons	Each	115,180	389	1.0	25,407	121	2.2

*Less than 0.05 per cent

TABLE 10. PERCENTAGE OF EACH COMMODITY OFFERED AS NEW ARRIVALS FOR SALE ON THE FARMERS' SECTION OF THE FRENCH MARKET BY PLACES OF ORIGIN, NEW ORLEANS, 1939*.

Commodity	PERCENTAGE COMING FROM EACH SECTION																
	Ascension	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Charles	St. James	St. John	Terrebonne	N. La.	W. La.	E. La.	Ala. and Miss.	Other states	Unknown	Total
Anise	0.1	60.9	0.0	5.4	18.3	8.0	4.3	0.8	0.7	0.0	0.8	0.7	0.0	0.0	0.0	0.0	100.0
Apples	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.7	0.0	100.0
Artichokes	0.0	0.0	0.0	0.0	96.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	100.0
Bay leaf	0.2	0.2	0.0	81.2	12.3	5.3	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Beans, fava	0.7	37.1	0.9	20.1	21.7	1.7	12.0	0.1	3.2	1.0	0.0	0.0	0.0	0.0	0.0	1.5	100.0
Beans, lima	†	9.4	5.9	18.2	39.5	1.3	8.0	5.8	1.4	6.0	†	1.3	0.8	0.2	0.0	2.2	100.0
Beans, snap	0.8	16.0	3.3	15.6	34.5	5.2	6.1	1.5	1.5	3.2	†	0.3	11.1	0.2	†	0.7	100.0
Beets	0.2	27.3	2.8	20.1	9.4	11.6	14.6	0.9	12.7	0.3	0.0	0.0	0.0	0.0	0.0	0.1	100.0
Beets, topped	0.0	18.5	40.8	22.2	11.1	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Blackberries	0.0	0.3	0.0	32.2	1.6	4.0	0.3	0.0	0.0	0.0	0.6	0.3	4.0	0.0	0.0	56.7	100.0
Broccoli	†	17.8	2.5	4.9	13.0	17.2	20.7	6.2	13.9	3.1	0.0	0.3	0.3	0.1	0.0	0.0	100.0
Cabbage	0.4	11.0	7.2	5.5	15.3	20.9	21.9	4.2	10.7	1.0	0.0	0.1	1.2	0.4	0.1	0.1	100.0
Cantaloupes	0.0	2.6	12.0	1.3	1.3	2.2	7.3	2.0	0.4	2.4	6.4	54.0	1.4	2.0	4.7	0.0	100.0
Carrots	0.1	35.2	8.0	13.2	4.1	11.8	13.6	3.0	10.3	0.4	0.0	0.1	0.1	0.0	0.0	0.1	100.0
Carrots (loose)	0.0	34.3	23.0	9.2	0.3	2.4	1.3	7.7	17.0	2.5	0.0	0.0	2.3	0.0	0.0	0.0	100.0
Cardonas	0.0	0.0	0.0	0.0	81.6	9.7	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	2.4	100.0
Cauliflower	0.8	1.5	0.4	45.5	10.8	16.8	4.3	16.1	0.8	0.6	2.4	0.0	0.0	0.0	0.0	0.0	100.0
Celery	0.0	3.9	3.9	14.6	0.0	7.7	0.0	14.6	50.5	4.8	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Celery, bunches	0.0	4.3	0.0	89.7	2.4	3.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.3	100.0
Cherries, wild	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Chives	0.0	22.9	0.0	44.8	19.9	0.0	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Chickory	0.0	45.7	0.0	49.8	0.5	0.0	3.6	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Cocozon	0.0	53.6	0.0	31.4	0.9	12.4	1.3	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	100.0
Collards	0.0	29.1	0.4	16.6	15.3	7.0	14.3	2.9	14.2	0.1	0.0	0.1	†	†	0.0	†	100.0
Cumquats	0.0	0.0	0.0	0.0	59.3	3.4	0.0	0.0	0.0	0.0	0.0	0.0	37.3	0.0	0.0	0.0	100.0

*The total amount of each commodity is shown in Table 9.

†Less than 0.05 per cent.

TABLE 10. Percentage of Each Commodity Offered as New Arrivals For Sale on the Farmers' Section of the French Market by Places of Origin, New Orleans, 1939—Continued

Commodity	Percentage coming from each section															
	Ascension	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Charles	St. James	St. John	Terrebonne	N. La.	W. La.	E. La.	Ala. and Miss.	Other states	Unknown	Total
Corn	0.3	9.6	13.6	7.2	10.3	12.2	33.5	1.0	7.4	4.1	0.0	0.3	0.2	†	0.0	0.3	100.0
Cowpeas	0.0	17.0	10.1	10.8	22.6	4.8	9.1	7.3	1.7	2.2	0.1	0.2	12.4	†	0.0	1.7	100.0
Cucumbers	0.0	6.7	0.5	1.5	47.0	2.6	3.4	0.3	2.6	2.7	0.2	0.0	32.4	†	0.0	0.1	100.0
Easter Lily plants	0.0	0.0	12.0	0.0	88.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Eggs	0.0	19.8	0.0	6.1	16.9	11.7	28.3	8.2	8.7	0.0	0.0	0.0	0.3	0.0	0.0	0.0	100.0
Eggplant	0.7	8.9	2.6	35.9	28.1	14.9	4.6	1.9	1.4	0.1	0.1	0.7	0.1	†	0.0	†	100.0
Endive	0.0	34.7	1.8	53.9	4.6	3.1	1.1	0.0	0.5	0.0	0.0	0.0	0.3	0.0	†	0.0	100.0
Escarole	0.0	32.9	42.8	2.4	6.0	10.8	1.8	0.2	0.0	0.0	0.0	1.3	0.0	0.0	0.0	1.8	100.0
Figs	0.0	1.3	1.1	2.5	77.1	12.8	1.0	0.0	0.1	0.0	†	0.0	0.0	0.0	0.0	4.1	100.0
File	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Flowers	0.0	0.0	0.0	14.5	60.9	7.3	17.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Garlic (sack)	0.0	2.3	21.6	1.9	3.3	1.3	0.1	0.0	0.0	0.0	0.0	66.9	1.3	1.3	0.0	0.0	100.0
Garlic (string)	0.6	3.0	71.1	1.1	7.7	1.5	2.5	4.2	0.5	0.6	0.1	2.9	4.2	0.0	0.0	0.0	100.0
Goatbeans	0.0	98.3	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Grapefruit	0.0	0.0	0.0	5.0	90.6	3.2	0.0	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Kale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Kohlrabi	0.0	1.2	0.5	39.1	4.5	4.5	0.8	0.0	48.0	0.8	0.0	0.4	0.2	0.0	0.0	0.0	100.0
Leek	†	5.6	0.0	86.1	1.2	3.9	1.4	0.0	0.4	0.0	0.0	0.0	0.8	0.0	0.1	0.5	100.0
Lemons	0.0	0.0	0.0	14.5	76.4	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Lettuce	0.0	9.2	15.7	7.5	53.4	3.3	8.2	0.7	0.5	0.8	0.0	0.1	0.0	†	0.0	0.6	100.0
Manderines	0.0	0.5	0.2	1.2	89.5	5.2	1.1	†	0.1	1.8	0.0	0.2	0.2	0.0	0.0	0.0	100.0
Mint	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Mushrooms	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Mustard	0.1	18.9	1.7	25.4	14.8	15.5	12.8	1.8	6.5	0.2	0.0	0.5	1.1	0.5	0.0	0.2	100.0
Okra	0.1	35.4	2.3	13.9	5.4	39.1	2.4	0.2	0.5	0.1	†	†	0.1	0.1	0.0	0.4	100.0

†Less than 0.05 per cent.

TABLE 10. PERCENTAGE OF EACH COMMODITY OFFERED AS NEW ARRIVALS FOR SALE ON THE FARMERS' SECTION OF THE FRENCH MARKET BY PLACES OF ORIGIN, NEW ORLEANS, 1939—Continued

Commodity	PERCENTAGE COMING FROM EACH SECTION																
	Ascension	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Charles	St. James	St. John	Terrebonne	N. La.	W. La.	E. La.	Ala. and Miss.	Other states	Unknown	Total
Onions, dry	0.0	5.9	74.2	0.9	3.2	1.3	0.5	0.0	0.1	2.4	0.7	9.3	1.3	0.1	0.0	0.1	100.0
Onions, green	†	9.7	70.0	0.7	8.7	2.5	3.7	0.1	2.3	0.4	0.0	1.9	0.0	0.0	0.0	0.0	100.0
Oranges, sweet	0.0	0.0	0.6	0.7	95.9	1.3	0.1	†	†	0.6	0.0	0.5	0.2	0.0	0.0	0.1	100.0
Oranges, naval	0.0	0.1	0.1	0.7	91.2	2.7	0.1	0.0	0.1	2.4	1.1	0.0	1.5	0.0	0.0	0.0	100.0
Parsley	0.1	27.9	2.2	26.8	11.4	21.2	5.7	0.6	3.5	†	†	0.3	†	0.0	†	0.3	100.0
Peaches	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.7	82.3	0.0	0.0	100.0
Peas, field	0.1	9.5	7.9	23.7	22.4	1.7	3.2	7.4	1.1	5.6	0.0	0.1	14.1	2.9	0.0	0.3	100.0
Peas, English	0.0	9.9	9.3	6.5	57.6	2.3	4.5	0.0	0.1	2.0	0.0	0.2	5.1	2.2	0.0	0.3	100.0
Pecans	0.0	0.0	0.8	1.9	7.7	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.2	86.9	0.0	0.0	100.0
Pear	0.0	3.6	3.0	13.4	69.1	1.2	1.5	0.6	0.6	3.6	0.5	0.7	1.9	†	0.0	0.3	100.0
Pepper, sweet	0.1	7.0	7.2	3.7	16.2	6.5	18.3	10.1	3.2	1.9	0.7	1.2	17.7	6.2	0.0	†	100.0
Pepper, hot	0.0	8.3	3.2	54.9	14.3	14.3	15.1	2.3	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	100.0
Persimmons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100.0
Pigs	0.0	21.8	0.0	14.1	0.0	0.0	0.0	0.0	0.0	64.1	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Plums	0.0	0.0	0.0	0.0	60.0	0.0	30.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Potatoes, Irish	0.4	3.8	61.9	1.0	3.5	1.0	1.6	3.0	0.7	9.7	0.0	11.2	1.3	†	0.0	0.9	100.0
Potatoes, sweet	0.0	4.2	7.2	0.4	5.3	0.4	0.8	0.1	0.3	0.1	0.0	80.5	0.4	0.0	0.0	0.3	100.0
Poke salad	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
Pomegranates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
Pumpkins	0.0	16.4	10.4	14.4	4.0	3.6	43.7	0.2	1.0	4.0	0.0	2.0	0.3	†	0.0	0.0	100.0
Radish	1.1	17.7	2.8	53.0	4.6	6.8	6.5	0.0	5.3	†	0.0	0.0	2.0	0.1	0.0	0.1	100.0
Rice	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Satsuma	0.0	0.7	0.6	1.7	93.5	2.0	0.5	0.0	0.3	0.2	0.0	0.4	0.0	0.0	0.0	0.1	100.0
Shallots, dry	0.0	0.7	62.2	0.5	0.2	0.0	0.5	0.0	0.0	1.3	0.0	0.0	34.6	0.0	0.0	0.0	100 0
Shallots, green	1.0	33.3	5.2	3.4	4.8	6.6	31.2	2.3	11.1	0.8	†	0.2	0.1	0.0	0.0	†	100.0

†Less than 0.05 per cent.

TABLE 10. PERCENTAGE OF EACH COMMODITY OFFERED AS NEW ARRIVALS FOR SALE ON THE FARMERS' SECTION OF THE FRENCH MARKET BY PLACES OF ORIGIN, NEW ORLEANS, 1939—Continued

Commodity	PERCENTAGE COMING FROM EACH SECTION																
	Ascension	Jefferson	Lafourche	Orleans	Plaquemines	St. Bernard	St. Charles	St. James	St. John	Terrebonne	N. La.	W. La.	E. La.	Ala. and Miss.	Other states	Unknown	Total
Snowball man	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99.9	100.0
Spinach	0.3	11.8	1.3	33.2	11.7	16.6	12.6	2.0	10.0	0.1	†	0.2	0.1	0.0	0.0	0.1	100.0
Spinach (Wh. leaf)	0.0	12.0	0.4	67.0	7.4	8.2	3.6	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.5	100.0
Squash (long)	0.0	38.7	0.9	49.6	0.0	4.7	0.2	0.0	0.0	0.0	0.0	0.0	0.3	5.6	0.0	0.0	100.0
Squash	†	12.9	0.2	7.7	32.4	6.7	4.3	0.6	2.4	1.2	0.2	0.2	30.9	†	0.0	0.3	100.0
Strawberries	2.3	0.4	0.0	2.0	0.0	5.7	0.5	0.0	0.0	0.0	4.0	0.0	85.1	0.0	0.0	0.0	100.0
Sugar cane	0.0	16.0	0.7	1.8	8.7	17.6	50.8	0.0	2.2	0.0	0.0	1.3	0.9	0.0	0.0	0.0	100.0
Syrup	0.0	32.2	1.7	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.2	0.0	0.0	0.0	100.0
Tangerines	0.0	0.1	0.3	0.8	94.4	3.6	0.0	0.0	0.0	0.6	0.0	0.0	0.2	0.0	0.0	0.0	100.0
Thyme	0.0	2.6	2.2	84.3	3.5	2.5	0.7	0.6	0.1	0.5	0.0	0.0	1.6	0.0	0.0	1.4	100.0
Tinarones	0.0	24.5	0.0	55.8	4.3	12.9	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	100.0
Tomatoes	†	18.3	0.2	15.4	16.2	35.2	10.5	0.0	1.3	†	0.1	0.5	0.3	1.3	0.6	0.1	100.0
Turnips	1.4	8.0	11.9	12.4	5.4	3.3	22.9	7.6	19.3	3.7	0.1	2.2	0.9	0.8	0.1	†	100.0
Turnip greens	0.0	0.0	0.0	0.0	0.0	0.0	41.6	0.0	30.6	0.0	0.0	25.7	2.1	0.0	0.0	0.0	100.0
Turnips, topped	0.0	0.0	14.1	0.0	0.3	0.0	0.0	3.9	81.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Vegetable pears	0.0	7.2	0.2	77.9	5.6	3.5	3.4	0.0	0.2	1.9	0.0	0.0	0.1	0.0	0.0	0.0	100.0
Watermelon	0.0	0.7	0.6	1.8	1.2	0.2	0.3	0.0	0.0	0.3	55.0	2.8	23.2	11.9	0.0	2.0	100.0
Number of commodities	28	70	59	76	73	69	65	42	58	48	24	42	55	31	9	41	92

†Less than 0.05 per cent.

berries. Orleans and adjoining parishes supplied a larger proportion of the more perishable crops. More than 75 per cent of the bay leaf, celery (bunches), leeks, mint, mushrooms, thyme, and vegetable pears came from Orleans parish alone. Only an insignificant amount of most products came from outside Louisiana and the few products which did originate outside the state in significate proportions were not very important from the standpoint of the total volume handled.

The largest number of commodities was 76 from Orleans Parish. The smallest number was 9 from states other than Louisiana, Alabama and Mississippi. In general the number of commodities sent to the market decreased as the distance from the market increased.

SUMMARY AND CONCLUSIONS

The supply of produce coming to the farmers' section of the French Market is largely local in character. Nearly 85 per cent of the 1,776 individuals, who had qualified to sell on the market in 1939, operated farms in ten parishes surrounding the city of New Orleans. Most of the farmers using the market operate small sized farms. The average area devoted to fruits and vegetables was only 28.5 acres in 1939.

The French Market constituted the sole outlet for the fruits and vegetables produced on more than 1,000 farms, or about 60 per cent of the total number using the market. Less than 11 per cent of the farmers using the market sold as much as 50 per cent of their produce elsewhere. The proper functioning of the market is therefore very important to a considerable number of people.

There was some difference of opinion between farmers, buyers, and market officials concerning the hours when the market should be open for business. Many of the farmers favored remaining open 24 hours per day, as was the practice several years ago. However, this would increase the expense of operating the market. It probably would not result in any increase in the total amount of business done, since the total demand for produce would not be changed.

One of the most controversial features of the market was the prices paid. The principal complaint from both buyers and sellers was that prices fluctuated too widely during most market days, and sometimes between different sections of the market at the same time. Despite the general dissatisfaction no one offered any feasible suggestions for reducing the amount of these fluctuations. The idea, expressed by some persons, that the government should set prices is impractical since no one can accurately tell in advance what price will result in the entire supply being sold.

One possibility for improving the price situation somewhat is to make more use of the market news reports issued by the Federal government. These reports are now issued daily and show prices being paid. Only about one-half of the farmers and buyers appeared to be acquainted with them. More use of these reports should result in better understanding of price situations on the market.

Another suggestion for improving the services of the market is to provide some means for the collective sale of small parts of a load left after most of it has been sold. Under present conditions farmers frequently take very low prices for the last part of their load rather than spend more time on the market waiting for better offers. This sometimes has a disrupting effect on the entire level of prices in the market. If arrangements could be made for some farmers' organization or dealer to take over the selling of such produce on a fee basis, the farmers might receive more money for it and market prices might remain more stable.

The Federal-State inspection service grades practically no produce on the French Market except in cases where grading is mandatory. Even in cases where produce is officially inspected and a grade certificate issued the buyers commonly inspect the produce itself before buying.

Under these circumstances the value of government inspection is much less than when produce is commonly bought and sold on the basis of official grade certificates. Another factor which reduces the value of the government inspection service in the French Market is the limited demand in New Orleans for high quality produce at premium prices. The comparatively low per capita income of the people seems to be responsible for this.

It has sometimes been proposed that the city of New Orleans establish another farmers' market in the "upper" part of the city, which is situated at a considerable distance from the French Market. This would appear to be unwise. The volume of produce coming into the city is not greater than can be handled conveniently with the facilities of the present market. An attempt to operate an additional market probably would result in such small volumes for each that neither market would be successful.

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Studies of the Production of Sweet Potatoes for Starch or Feed Purposes

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STUDIES OF THE PRODUCTION OF SWEET POTATOES FOR STARCH OR FEED PURPOSES

W. D. Kimbrough

INTRODUCTION

The Sweet Potato Starch Plant at Laurel, Mississippi, has demonstrated conclusively that high grade starch can be made from sweet potatoes. While being suitable for ordinary uses, this starch can be used in the manufacture of adhesives. The development of the sweet potato starch industry in this country has been retarded because of the competition it faced from cassava flour which has been imported and sold at a low price. The present war emergency may, at least temporarily, increase the interest in and necessitate an immediate increase in the production of sweet potato starch in this country.

Probably of greater importance than the production of starch is the potential value of dehydrated sweet potatoes as a livestock feed. Experiments are being conducted in several southern states with dehydrated sweet potatoes for farm animals and the results have been very promising. If the livestock industry in the South is to develop as it should and as it is expected to, something must be done about the feed problem. The use of the sweet potato may be the answer to a major part of this difficulty.

The methods of production of sweet potatoes for feed or starch differs from those used to produce crops for table stock. Total solid content and yield of all useable potatoes are the important factors for successful feed and starch production. If potatoes are not cracked too badly to wash easily and are not so stringy that they interfere with the machinery they can be utilized. Great care at digging time is not so essential as the potatoes are not kept for very long periods but the potatoes should be as free from dirt as possible. This means that larger yields may be obtained and cost may be reduced over that in the production of potatoes for the market or storage where very careful handling is essential.

REVIEW OF LITERATURE

There is very little available information either on the culture of sweet potatoes for starch and feed or the utilization of the sweet potatoes for these purposes. The first report of the production of sweet potato starch upon a commercial scale is that of Paine and others (6) who described their process of the manufacture of this starch in a paper published in December 1938. Since that time some modifications have been made in the plant at Laurel, Mississippi. Guin and others (3) reported on the factors for success on starch sweet potato and general farms in Jones County, Mississippi in 1939. Their data showed that it cost 25 cents per bushel to produce sweet potatoes in that area.

Anderson (1) reported results of fertilizers for starch sweet potatoes in Mississippi. Hoffman and Lutz (4) reported work done on delayed harvest of sweet potatoes for industrial purposes. They state, "It appears practicable to harvest sweet potatoes for immediate starch manufacture as late as November 20 to 30, a month later than the usual harvesting date for sweet potatoes in the vicinity of Meridian, Mississippi." Ware (7) reported very interesting results concerning dehydration on sweet potatoes by methods that can be used on the farm. The shredded potatoes were easily air dried in the open when spread out on suitable material such as building paper. This method seems very promising.

It has been demonstrated (2, 5) that the time of planting sweet potatoes materially affects the total yield at a given date. The earlier the potatoes can be set to field without injury from cold the larger the yield.

THE PROBLEM

If starch or feed is to be made from sweet potatoes it must be profitable to both the growers and the manufacturers. The returns per acre must be profitable to the grower or he will not be interested in growing the crop, especially as it is one he may not be too familiar with. The starch mill should operate over as long a period as possible so that expensive equipment will not be standing idle longer than necessary. Therefore, information is needed on the effect of planting date and time of digging on the yield and starch content of sweet potatoes. This is important so that it may be known approximately how soon the factory may start and how far into the winter it may operate. Furthermore, spacing distance of sweet potato plants grown for industrial use is an important factor especially for earlier plantings when draws or slips are scarcer and more expensive.

The work reported in this paper was conducted to get much needed information concerning these important problems.

The Triumph variety has been used in the production of starch so far. It has been grown for a number of years as a table variety and was selected because it was the best variety for starch of which seed was readily available. No sweet potato had been selected or developed in this country because of its adaptability to starch or feed production. For this reason information concerning varieties is important.

PROCEDURE

The sweet potatoes used in these experiments were grown on the Experiment Station at Baton Rouge in a fairly uniform Lintonia silt loam soil. Plots 40 x 4 feet replicated five times were used. All plots received 400 pounds of 4-12-4 fertilizer per acre.

Dates of planting used were approximately April 10, May 10, June 10, and July 10. Potatoes were dug July 15, August 15, September 15, October 15, November 15, and December 15.

Samples for analysis were taken the day after digging. Moisture, reducing sugars, total sugars, and starch determinations were made on the samples taken.

In the spacing tests the following intervals between plants in the row were used: 12 inches, 18 inches, 24 inches, and 36 inches.

Triumph was the principal variety worked with but during the course of the experiment Porto Blanco, Wennop, and L 4-5 were also used.

Yields are given as total useable bushels per acre, for starch or feed, which includes jumbos, No. 1's and No. 2's, but does not include the strings. A bushel of sweet potatoes for this purpose is considered to be 60 pounds.

DATE OF PLANTING EXPERIMENT

As was previously stated, the date of setting sweet potato slips or cuttings to the field influences the yield of potatoes produced. Total yield is not as important when growing table stock sweet potatoes as the yield of marketable potatoes. Total yield is, however, the important factor in the production of sweet potatoes for feed or starch, for the price per bushel is lower on this type of potato and a high yield must be produced economically to give good per acre returns to the grower. Large, so-called jumbo potatoes are satisfactory and in fact the whole crop except the strings and any decayed potatoes may be used for the production of feed and starch.

The data obtained on the effect of date of planting on yield and carbohydrate content of sweet potatoes dug the middle of October are given in Table 1. These data show that the earlier the potatoes were planted the larger the yields produced. The results of these tests demonstrate that potatoes grown for manufacture of feed and starch should be planted as soon as possible after danger from cold injury is past. For south Louisiana it is recommended that the plantings be made from the middle of April to the middle of May. Yields obtained in these tests were sufficient to give a profitable return per acre at prices paid for feed and starch potatoes. There was little difference found in the sugar content of sweet potatoes when planted at different dates and there was not a great deal of difference in starch content except that the starch content tended to be lower in potatoes planted in July.

TABLE 1. Effect of Date of Planting on Yield of Sweet Potatoes Dug October 15

Variety	Date of planting	Yield in bushels per acre	Moisture per cent	Sugar—Per cent		Starch per cent
				Reducing	Total as invert	
Triumph*	April	449.4	68.7	0.15	1.75	22.2
	May	345.9	67.7	0.14	1.54	22.5
	June	239.3	68.3	0.16	1.60	22.5
	July	99.4	68.6	0.14	1.57	21.6
Wennop†	April	527.8	69.1	0.21	1.77	21.7
	May	441.5	69.6	0.24	1.71	20.9
	June	299.0	70.6	0.29	1.86	20.4
	July	156.7	72.0	0.46	1.93	18.4
L 4-5‡	April	497.6	63.74	0.71	1.71	26.5
	May	401.6	65.09	0.26	1.69	25.4
	June	316.7	66.00	0.30	1.63	24.3
	July	183.5	67.20	0.32	1.54	23.0

*Four year average 1938-1941.
†Three year average 1938-1940.
‡Two year average 1940-1941.

TIME OF DIGGING EXPERIMENT

For starch and feed purposes the grower is interested in obtaining a very large yield per acre therefore the plants should grow as long as possible. If this could be done all potatoes would be dug late in the season. If all the potatoes were harvested at about the same time there would be congestion in the delivery of potatoes to the mill, which would cause delays and probable spoilage of some potatoes. The mill, on the other hand, must run for as long a period as possible so as to reduce overhead and to produce more starch and utilize more potatoes. Therefore, information concerning yields and composition of potatoes dug at different times is of practical importance. Data on these questions are given in Tables 2 and 3. These data are not averaged as all digging dates were not the same every year for the different planting times.

These data show that the longer the growing season of the potatoes the higher the yields produced. For example potatoes set in April and dug the middle of August produced fair yields and the starch content was fair. Plots harvested in September gave a greater yield than those dug in the previous month. The data show that under the conditions of this experiment a growing period of four months is necessary to produce a fair yield of potatoes. For this reason the mills cannot start operations before August or probably not until September. From the growers' standpoint October and November are the best months for the harvest of sweet potatoes so far as yield is concerned. The weather is usually favorable for harvest in south Louisiana in October and part of November. As

TABLE 2. Effect of Time of Digging on Yield and Composition of Triumph Sweet Potatoes Planted at Different Times.

Date of planting	Date of digging	Yield in bushels per acre	Moisture per cent	Sugar—Per cent		Starch per cent	Pounds of starch per acre
				Reducing	Total		
1938							
April	July	217.8	74.12	0.18	1.55	18.1	2365.3
April	August	378.1	71.19	0.16	1.93	20.4	4627.9
April	October	539.2	68.61	0.17	1.79	23.1	7473.3
May	August	215.3	69.31	0.19	2.05	22.4	2893.6
May	September	346.0	68.89	0.15	1.83	23.1	4795.6
May	October	401.5	66.11	0.16	1.57	23.1	5564.8
May	November	478.5	67.56	0.16	1.86	22.3	6402.3
June	August	49.7	72.75	0.22	1.93	18.9	563.6
June	September	133.8	68.31	0.28	1.68	23.1	1854.5
June	October	237.6	65.16	0.16	1.54	24.7	3521.2
June	November	254.2	68.21	0.17	1.79	22.5	3431.7
1939							
April	July	158.5	70.32	0.21	2.06	21.1	2006.6
April	August	290.1	68.03	0.16	1.56	22.7	3951.2
April	September	379.8	70.20	0.16	2.17	19.9	4534.8
April	October	521.6	69.41	0.14	1.63	22.1	6916.4
May	August	195.0	69.42	0.16	1.50	22.9	2679.3
May	September	430.4	71.30	0.15	1.89	18.9	4880.7
May	October	426.5	68.60	0.14	1.53	22.8	5834.5
May	November	439.3	67.66	0.18	1.92	23.9	6299.6
June	September	122.2	68.41	0.15	1.67	22.5	1649.7
June	October	185.5	67.56	0.16	1.77	24.4	2715.7
June	November	290.6	69.47	1.17	1.83	22.5	3923.1
1940							
April	September	378.0	71.64	0.21	2.27	18.9	4286.5
April	October	303.0	66.74	0.15	1.57	23.1	4200.0
May	September	123.2	71.10	0.24	2.02	18.5	1367.5
May	October	236.0	66.50	0.15	1.23	23.6	3341.8
May	November	337.9	67.51	0.13	2.38	21.7	4399.5
June	September	196.1	70.67	0.20	1.72	19.5	2294.4
June	October	262.6	69.61	0.15	1.49	20.5	3230.0
June	November	363.7	69.14	0.14	2.39	19.7	4298.9

(Table 2 continued on next page)

TABLE 2. Effect of Time of Digging on Yield and Composition of Triumph Sweet Potatoes Planted at Different Times.—Continued

Date of planting	Date of digging	Yield in bushels per acre	Moisture per cent	Sugar—Per cent		Starch per cent	Pounds of starch per acre
				Reducing	Total		
			1941				
April	August	292.3	68.52	0.21	2.24	21.7	3805.7
April	September	349.9	68.70	0.17	2.05	21.0	4408.7
April	October	433.7	70.00	0.12	1.99	20.4	5308.5
May	August	148.6	70.62	0.17	1.99	19.3	1720.8
May	September	228.5	71.44	0.15	1.98	19.7	2700.9
May	October	320.7	69.66	1.12	1.81	20.5	3944.6
May	November	446.2	72.92	0.16	2.05	17.1	4578.0
June	September	129.0	71.73	0.32	1.66	18.9	1462.9
June	October	271.3	71.04	0.18	1.59	20.2	3288.2
June	November	385.8	68.73	0.13	2.01	21.3	4930.5

TABLE 3. Effect of Time of Digging on Yield and Composition of L 4-5 Sweet Potatoes Planted at Different Times.

Date of planting	Date of digging	Yield in bushels per acre	Moisture per cent	Sugar—Per cent		Starch per cent	Pounds of starch per acre
				Reducing	Total		
			1940				
April	September	296.3	64.34	0.63	1.97	25.1	4462.3
April	October	417.3	64.57	0.27	1.62	25.2	6309.6
May	September	190.1	66.10	0.60	1.83	22.2	2532.1
May	October	346.8	65.64	0.24	1.57	24.4	5077.2
May	November	422.2	64.40	0.20	2.46	24.2	6130.3
June	October	317.8	66.70	0.32	1.60	23.3	4442.8
June	November	476.1	66.21	0.26	2.79	21.0	5998.9
			1941				
April	August	284.8	63.55	0.31	1.71	27.5	4699.2
April	September	420.6	61.88	0.28	1.63	28.7	7242.7
April	October	577.9	62.71	0.26	1.79	27.8	9639.4
May	August	166.1	63.35	0.30	1.71	27.9	2780.5
May	September	272.7	64.13	0.28	1.64	27.0	4417.7
May	October	456.4	64.53	0.27	1.81	26.4	7229.4
May	November	637.7	66.12	0.21	2.27	24.0	9182.9

earlier diggings are likely necessary from the standpoint of the mill, proportionate allotments should be made all the growers supplying the mill and these should come from early planted potatoes.

It is known that yield and composition of sweet potatoes will vary greatly with the weather conditions. The starch content in a variety of sweet potatoes may vary as much as 10 per cent. The starch content in sweet potatoes of the Triumph variety was not as high under the conditions of this experiment as has often been found elsewhere. Anderson (1) reports considerably high starch contents in potatoes of the Triumph variety grown in Mississippi.

Weather conditions in south Louisiana are usually suitable for drying of sweet potatoes in the open in September and October.

DELAYED DIGGING TEST

In connection with the time of digging test studies have been made in connection with delaying of digging time until a period after the vines have been killed by frost. At the present time it is not feasible to dig and store potatoes that are to be used for starch and feed. If, however, the potatoes could be kept in the ground and dug as needed the mills could be kept running longer. With this in mind some potatoes were not dug until the middle of December. Preliminary tests had shown that with the soil type used in these experiments and under climatic conditions of Baton Rouge the potatoes could not be held in the ground until January 15. Data obtained from potatoes planted in June are given in Tables 4,

TABLE 4. Effect of Delayed Digging on the Composition and Percentage Rot in Triumph Sweet Potatoes Planted June 10.

Year grown	Date of digging	Yield in bushels per acre	Rot per cent	Moisture per cent	Sugar—Per cent		Starch per cent
					Reducing	Total	
1938...........	October.......	237.6	0.0	65.16	0.16	1.54	24.7
"	November.....	254.2	0.0	68.21	0.17	1.79	22.5
"	December.....	269.4	0.0	68.93	0.28	3.63	20.7
1939...........	October.......	185.5	0.0	67.56	0.16	1.77	24.39
"	November.....	290.6	0.0	69.47	0.17	1.83	22.50
"	December.....	231.9	0.0	69.38	0.18	2.46	20.52
1940...........	October.......	262.6	0.0	69.61	0.15	1.49	20.52
"	November.....	363.7	0.0	69.14	0.14	2.39	19.71
"	December.....	283.9	3.6	71.37	0.16	2.94	17.60
1941...........	October.......	271.3	0.0	71.04	0.18	1.59	20.19
"	November.....	385.8	0.0	68.73	0.13	2.01	21.27
"	December.....	414.6	0.2	69.49	0.19	2.82	19.77

5, and 6. Data from July plantings were omitted as this planting date is not recommended for potatoes to be used for starch or feed.

TABLE 5. EFFECT OF DELAYED DIGGING ON COMPOSITION AND PERCENTAGE OF ROT IN WENNOP SWEET POTATOES PLANTED JUNE 10.

Year grown	Date of digging	Yield in bushels per acre	Moisture per cent	Rot per cent	SUGAR—PER CENT		Starch per cent
					Reducing	Total	
1938	October	307.1	68.71	0.0	0.32	1.90	21.4
“	November	370.0	70.95	0.0	0.29	1.66	23.1
“	December	390.6	70.94	0.0	0.42	4.68	17.6
1939	October	309.5	70.72	0.0	0.32	1.85	21.15
“	November	339.0	69.19	0.0	0.26	1.93	22.68
“	December	355.0	73.00	0.0	0.29	2.06	18.27
1940	October	280.4	72.37	0.0	0.36	1.83	18.45
“	November	406.6	71.93	0.0	0.33	2.82	17.73
“	December	458.8	72.21	0.2	0.36	3.22	16.65

These data show that potatoes left in the ground until the middle of December had a higher moisture content, more total sugar and less starch than those dug in October or November. Potatoes dug in November tended to have a little less starch than those dug in October. Digging conditions in December were usually bad due to the soil being muddy. The percentage of rotten potatoes varied somewhat from year to year but was not high in any year. This might have been higher in potatoes that had been planted earlier.

It is believed that digging should not be put off until December. The mills might prefer, however, to run with inferior potatoes rather than not run at all.

TABLE 6. EFFECT OF DELAYED DIGGING ON COMPOSITION AND PERCENTAGE ROT IN L 4-5 SWEET POTATOES PLANTED JUNE 10.

Year grown	Date of digging	Yield in bushels per acre	Moisture per cent	Rot per cent	SUGAR—PER CENT		Starch per cent
					Reducing	Total	
1940	October	317.8	66.70	0.0	0.32	1.60	23.27
“	November	476.1	66.21	0.0	0.26	2.79	20.97
“	December	348.5	68.64	2.0	0.46	3.75	19.35
1941	October	315.5	65.30	0.0	0.27	1.66	25.32
“	November	433.6	66.84	0.0	0.25	2.32	23.43
“	December	468.7	66.71	0.7	0.31	2.98	22.50

SPACING TEST

As best yields are obtained from sweet potato plants set to the field as early as possible after danger from cold is over, the spacing distance of plants is important, because plants are scarcer and more expensive early in the season. For starch and feed large sized potatoes are not undesirable, and may even be preferable. This means that spacing for these purposes can be different from that used in growing potatoes for food purposes. To get some information on this subject a spacing test was run. The data obtained are shown in Table 7.

TABLE 7. Effect of Planting Distance on the Yield of Triumph Sweet Potatoes Dug in October.

Date of planting	Inches spacing	Yield in bushels per acre			
		1939	1940	1941	3-Yr. Ave.
April*	12	521.6	307.3	424.3	417.7
	18	466.5	303.0	433.7	401.1
	24	456.5	440.0	380.9	419.3
	36	387.9	388.9	368.3	381.7
May*	12	426.5	220.3	362.7	336.5
	18	477.9	236.0	320.7	344.9
	24	413.6	202.0	338.6	318.1
	36	376.9	205.4	343.5	308.6
June†	12	185.5	289.1	295.8	256.8
	18	173.4	262.6	271.3	235.8
	24	237.2	252.2	246.9	245.4
	36	148.3	209.1	201.9	186.4

*No significant differences in yield for 3-year average.
†23.0 bu. required for significance at the .05 point for 3-year average.

No significant differences in yield were found in the three year average for the different spacing used in this test when plants were set to the field in April or May. Plants spaced 36 inches apart produced significantly lower yields than those from other spacings used when the plants were set in June. The data indicate that slips may be set two feet or even three feet apart in the rows and not materially affect the yield when set to the field at the proper time. Replanting, if not delayed, may be more important and more effective than where closer spacing is used because of the larger interval between plants.

VARIETIES

During the course of this experiment four varieties of sweet potatoes were used, although Triumph was the principal one and was considered to be the standard. Porto Blanco, a mutation of the Porto Rico, was grown for two years, but it was found to be inferior to Triumph in starch content and was not superior in yielding ability. The Wennop variety was tested for three years. Potatoes of the latter variety were reported by Paine and others (6) to have a higher starch content than in those of the Triumph variety. This was not found to be true under the conditions of these experiments for the Triumph potatoes were usually as high or higher in starch content than those of the Wennop variety. The Wennop was found to be in general a better yielding variety than the Triumph. The main difficulty with the potatoes of this variety is that they contain a relatively large amount of latex or milky material. When this material dries it retains soil which is very difficult to wash off and is injurious to the machinery in a starch plant.

For the last two years the seedling L 4-5, developed by Dr. Julian C. Miller of this Station, has been tested. For a comparison of the variety Triumph and the seedling L 4-5 the data in Table 3 and the 1940 and 1941 part of Table 2 may be used. This seedling has been very promising indeed. The L 4-5 has been found to be not only as good a yielder as the Triumph but better as a late variety. Furthermore potatoes of this variety have consistently had a higher starch content than those of the Triumph. It is realized that two years is not a long enough time to be certain about the yielding capacity of a variety, but the present indications are that the L 4-5 will likely replace the Triumph as a starch and feed variety.

It should be pointed out that until very recently no attempt had been made in this country to breed for sweet potatoes especially adapted to starch or feed purposes. A successful method for obtaining true seed from sweet potatoes in the continental United States was worked out by Dr. Julian C. Miller and has made an extensive breeding program possible. Since 1939 the U. S. Department of Agriculture and several southern experiment stations have been conducting a cooperative program from which may be expected improvement in both table stock and starch and feed potatoes. This means that we may expect a variety that will be superior to L 4-5. As past experience has shown, in general the better a variety is, the more difficult for the plant breeder to improve on it.

CONCLUSIONS

The results that are given show that high yields of sweet potatoes produced for feed and starch purposes are dependent on cultural practices. This may be especially important during war times when certain imports are cut off or restricted. More starch per acre can be produced from sweet potatoes than from any other crop grown commercially in this country. This is also true for carbohydrate livestock feed. The highest yields can be obtained by setting plants to the fields as soon as possible after danger from cold injury has passed. In south Louisiana this means that slips should be set from April 15 to May 15. However, at this time plants are scarce and expensive. As large potatoes are preferable for starch and feed manufacture, early plants can be set farther apart than would be suitable for potatoes grown for table use. For this reason spacings two to three feet apart are recommended. Experimental data show that it is doubtful if profitable yields can be produced in growing periods shorter than four months. The results of these tests show that the longer the potatoes can grow the larger the yields. However, for the mills to run over as long a period as possible the digging of the potato crop must extend over as long a period as possible. This can be arranged between the mill managers and growers so as to be fair to all concerned. From experience and tests, diggings more than a month after a killing frost are very likely to give inferior potatoes.

Tests to date show that the seedling L 4-5 is very promising and seems likely to replace Triumph as a starch and feed variety. In the future improved seedlings may be expected from the present breeding program.

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Seed and Soil Treatment *for the* Control of Damping-Off

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SEED AND SOIL TREATMENT FOR THE CONTROL OF DAMPING-OFF

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INTRODUCTION

The disease commonly called damping-off affects many plants in the seedling stage. There are two phases of damping-off which are known as pre-emergence damping-off and post-emergence damping-off. In pre-emergence damping-off the seeds and young seedlings rot in the soil and never reach the surface. This may result in poor stands even when good seed are used. In the post-emergence damping-off the young plants become water-soaked at the soil line, collapse suddenly, and die. Most growers are usually more familiar with post-emergence damping-off and believe that it is caused by excessive moisture and periods of cool, cloudy weather. While these conditions are favorable for damping-off, the disease is caused by fungi that live in the soil or which are sometimes introduced with the seed. Isolations made over a period of three years from diseased seedlings indicate *Rhizoctonia* and *Pythium* to be the fungi mainly involved in Louisiana.

Previous Work

Seed treatments for the control of certain seed-borne diseases have been recommended for some years, but only within the past 14 years has much work been done with seed of vegetable crops. In 1928 Clayton tested in the field and greenhouse a number of organic mercury compounds (Semesan, Uspulun) on vegetable seeds. Some of the treatments gave striking increases in stands in the greenhouse in midwinter, but in late spring there was little or no increase in stands from similar treatments. In 1930 Horsfall (3), in tests in greenhouses in New York, found that soaking tomato seed in copper sulfate solution gave remarkable increases in stand and the emerged seedlings were relatively free of disease. He also obtained increased stands by dusting seeds with cuprous oxide and other copper compounds. Later Horsfall (5) and co-workers studied the effect of the red copper oxide seed treatment on a large number of different plants. These treatments increased stands and gave very promising results on several vegetable crops. Horsfall (4) also found that zinc oxide when applied on the soil surface as a supplement to seed treatment gave satisfactory control of post-emergence damping-off of lettuce, peppers, spinach, and tomatoes. Wilson and Tilford (7) found formaldehyde dust to be a satisfactory substance for controlling damping-off on a number of vegetable crops in Ohio. Cook and Callenbach (1) tested a number of compounds for the control of spinach damping-off in Virginia. They found that treatments with red copper oxide, zinc oxide, Semesan, and other materials increased stands in early fall plantings, but later plantings showed no benefit. Kadow and Anderson (6) made numerous tests with various seed and soil treatments under Illinois conditions.

Objectives

A number of seed and soil treatments for the control of damping-off have come into commercial use during the last few years. As most of the results published on these treatments have come from Northern areas where conditions are different from those in the South, it seemed important to test, under Louisiana conditions, some of the more promising compounds which have been used for treating seeds and soil. This bulletin gives the results of tests with seed of certain vegetables and ornamental plants made during the last seven years.

These tests were conducted mostly in the University greenhouse at Baton Rouge. Soils of two types, Sharkey and Olivier, were used. The Sharkey is the common alluvial soil characteristic of the Mississippi River bottom. The Olivier is the upland or terrace soil occurring in East Baton Rouge Parish. Fresh soil was obtained for each test. This was screened and then thoroughly mixed to insure uniformity. Most of the tests were made in small flats, but a few were carried on in stationary benches in the greenhouse.

For these tests seeds were obtained from various commercial dealers. In the early tests, from 8 to 14 rows of 100 seeds each were planted in each flat. In later tests the number of seeds used for each treatment was reduced to 400 and the various treatments were replicated in 4 flats.

A number of different chemical compounds were tested in the treatments. These included red copper oxide (Cuprocide), yellow copper oxide, formaldehyde solution, various formaldehyde dusts, zinc oxide, Vasco 4, Spergon, and several of the organic mercury dusts.

The formaldehyde dusts were applied at the rate of 1½ ounces per square foot by mixing into the upper 3 inches of the soil. The flats were watered thoroughly immediately after planting.

The concentrated formaldehyde treatment was made by applying 30 cc. of formaldehyde (40% commercial formaldehyde) per square foot of soil. The formaldehyde was diluted to five or six times its volume with water, sprinkled over the soil, and mixed thoroughly into the upper four inches. The soil was allowed to stand from 24 to 36 hours after treatment.

The seed treatments, including those with the copper oxides, were made by shaking the seed in a closed container with an excess of the dust to be tested until well-covered. In all cases the excess dust was removed after treatment.

Zinc oxide and Vasco 4 when used to treat the soil surface were applied at the time the seedlings began to emerge by shaking on enough to cover the soil thoroughly. The quantity necessary to obtain good coverage was about 20 grams to the square foot of soil.

Yellow copper oxide was also used in suspension to treat the surface of the soil as the seedlings emerged. The concentration was 1¼ ounce of the oxide to one gallon of water.

In all tests the flats were held under conditions as nearly alike as possible. The flats were kept somewhat more moist than under normal growing conditions in order to give the treatments as drastic a test as possible.

After the seedlings emerged from the soil the plants were removed and counted as they damped off. At the end of the test the remaining plants were counted. By this method both the number of plants that emerged from the ground and the actual number of plants which remained at the end of the tests were determined. Final counts were made when damping-off had stopped.

Experimental Results

The results which were obtained in the various seed and soil treatment tests conducted over a period of years are presented in the following pages. In most cases these are presented in tables so arranged as to give a comparison of the efficiency of the more important compounds which are in general use or have been recommended for treating seed and soil.

In table 1 are included the results obtained in tests in which red copper oxide and two commercial formaldehyde dusts were compared. The copper oxide was used to treat the seed and the formaldehyde dusts were used to treat the soil. Seeds of bell pepper, eggplant, and tomato were used in the tests.

All the treatments about doubled the emergence and stand of tomatoes. The red copper oxide seed treatment was slightly superior to the formaldehyde dusts. The increases in emergence and stand were not as striking with bell peppers as with tomatoes, the untreated seed giving an average stand of 48.9 per cent and the treatments from 58.6 per cent to 61.3 per cent. The red copper oxide seed treatment also resulted in the best stands with bell peppers. With eggplants considerably better results were obtained with the red copper oxide than with the formaldehyde dusts. It nearly doubled both emergence and stand but post-emergence damping-off was heavy, as 55.9 per cent of the seed produced plants which emerged from the soil while only 31.6 per cent remained at the end of the tests. It is interesting to note that even though damping-off was more severe in the Olivier soil than in the Sharkey soil, the seed and soil treatments gave about the same number of plants emerging from both soils.

TABLE 1. Results of Tests Comparing Red Copper Oxide and Two Formaldehyde Dusts. The Copper Oxide Was Used to Treat the Seed and the Formaldehyde Dusts to Treat the Soil.

Soil type	Number of tests	Total number of seed	Per cent emergence				Per cent stand			
			Check	Red copper oxide	Formaldehyde dust		Check	Red copper oxide	Formaldehyde dust	
					No. 1*	No. 2*			No. 1*	No. 2*
Tomatoes										
Sharkey	8	7,000	40.1	69.0	68.8	65.6	37.6	65.0	64.7	62.3
Olivier	8	7,000	29.2	75.8	63.7	69.0	26.8	72.4	62.7	67.6
Average		14,000	34.7	72.4	66.8	67.3	32.2	68.7	63.7	65.0
Bell Peppers										
Sharkey	7	6,100	53.0	64.3	64.5	60.1	48.3	60.4	60.9	55.6
Olivier	7	6,100	54.7	65.0	60.8	67.8	49.5	62.1	56.3	63.3
Average		12,200	53.9	64.7	62.7	64.0	48.9	61.3	58.6	59.5
Eggplants										
Sharkey	8	7,000	30.9	53.3	35.6	31.7	17.6	30.2	19.3	18.4
Olivier	8	7,000	32.4	58.5	37.8	45.9	19.3	33.0	27.8	24.2
Average		14,000	31.6	55.9	36.7	38.8	18.5	31.6	23.6	21.3

*Formaldehyde dust No. 1 was obtained from the Grasselli Chemical Co., and No. 2 from the Ansul Chemical Co.

In table 2 are included results of tests in which Formacide was compared with red copper oxide. The Formacide was used to treat the soil and the copper oxide to treat the seed. With tomatoes and bell peppers Formacide gave about the same increases in stands as did the red copper oxide. With eggplants it was less efficient.

TABLE 2. RESULTS OF TESTS COMPARING RED COPPER OXIDE AND FORMACIDE. THE COPPER OXIDE WAS USED TO TREAT THE SEED AND THE FORMACIDE TO TREAT THE SOIL.

Soil type	No. of tests	Total number seed	PER CENT EMERGENCE			PER CENT STAND		
			Check	Red copper oxide	Formacide*	Check	Red copper oxide	Formacide*
TOMATOES								
Sharkey.......	9	8,000	52.6	80.8	78.0	46.7	74.0	70.0
Olivier.........	9	8,000	35.4	80.8	72.5	32.6	77.4	71.8
Average...		16,000	44.0	80.8	75.3	39.7	75.7	70.9
BELL PEPPERS								
Sharkey.......	9	8,000	61.0	74.1	74.1	56.0	70.3	68.5
Olivier.........	9	8,000	59.7	70.3	73.3	53.0	67.8	70.3
Average...		16,000	60.4	72.2	73.7	54.5	69.0	69.4
EGGPLANTS								
Sharkey.......	8	7,100	39.4	61.7	47.0	22.2	39.2	24.0
Olivier.........	8	7,100	41.9	65.8	47.0	21.4	43.5	38.0
Average...		14,200	40.7	63.8	47.0	21.8	41.4	31.0

*Formacide was obtained from the Hammond Paint and Chemical Co.

In table 3 are included results of tests in which formaldehyde (40% solution) was compared with red copper oxide. The formaldehyde was used to sterilize the soil before the seed were planted, while the copper oxide was used to treat the seed. The results show that with tomatoes the formaldehyde was slightly more efficient than red copper oxide. Emergence and stand were about the same with peppers. In the Sharkey soil the formaldehyde soil treatment was much superior to the red copper oxide seed treatment in preventing post-emergence damping-off. In one test made in the Olivier soil it seemed to be toxic to eggplant seed, causing a reduction in germination.

TABLE 3. RESULTS OF TESTS COMPARING RED COPPER OXIDE AND FORMALDEHYDE SOLUTION (40%). THE COPPER OXIDE WAS USED TO TREAT THE SEED AND THE FORMALDEHYDE TO TREAT THE SOIL.

Soil type	No. of tests	Total number seed	PER CENT EMERGENCE			PER CENT STAND		
			Check	Red copper oxide	Formaldehyde	Check	Red copper oxide	Formaldehyde
				TOMATOES				
Sharkey.......	4	4,200	50.0	83.5	88.1	43.2	74.8	85.6
Olivier.........	4	4,200	27.1	75.8	72.9	24.6	71.0	72.8
Average...		8,400	38.6	79.7	80.5	33.9	72.9	79.2
				BELL PEPPERS				
Sharkey.......	4	4,200	66.5	83.2	83.7	60.5	79.1	81.1
Olivier.........	4	4,200	55.2	76.0	70.3	50.1	74.1	66.9
Average...		8,400	60.9	79.6	77.0	55.3	76.6	74.0
				EGGPLANTS				
Sharkey.......	3	3,300	60.7	73.4	73.4	26.3	43.4	66.6
Olivier.........	1	900	32.6	74.3	28.7	9.2	24.9	28.7
Average...		4,200	46.7	73.9	51.0	17.8	34.2	47.7

In table 4 are included results of tests in which Ceresan was compared with red copper oxide. Both were used to treat the seed. Increases of stands of tomatoes were about the same with Ceresan as with the copper oxide. Ceresan, however, was definitely toxic to both bell peppers and eggplants in the Olivier soil, the germination being lowered.

In table 5 are included results of tests in which red copper oxide obtained from the Merck Chemical Company was compared with Metrox, or commercial red copper oxide obtained from the Metals Refining Co. These products were about equally efficient.

In table 6 are included results of tests to determine the value of zinc oxide as a soil dressing. The seeds were treated with red copper oxide before planting and the zinc oxide was applied to the soil at the time of emergence of the seedlings. The zinc oxide was of little value with tomatoes and bell peppers, but decreased considerably the post-emergence damping-off of eggplants.

TABLE 4. RESULTS OF TESTS COMPARING RED COPPER OXIDE AND CERESAN. BOTH USED TO TREAT THE SEED.

Soil type	No. of tests	Total number seed	PER CENT EMERGENCE			PER CENT STAND		
			Check	Red copper oxide	Ceresan	Check	Red copper oxide	Ceresan
					TOMATOES			
Sharkey.......	5	4,300	50.2	77.3	81.5	44.0	66.5	63.4
Olivier.........	5	4,300	31.9	78.5	80.7	28.1	73.0	70.4
Average...		8,600	41.0	77.9	81.1	36.1	69.8	66.7
					BELL PEPPERS			
Sharkey.......	5	4,300	59.3	73.6	76.0	52.0	67.6	64.2
Olivier.........	5	4,300	62.0	75.4	40.6	54.4	71.4	38.1
Average...		8,600	60.7	74.5	58.3	53.2	69.5	51.2
					EGGPLANTS			
Sharkey.......	4	3,400	35.1	57.8	53.4	20.1	30.0	27.7
Olivier.........	4	3,400	41.8	64.1	28.9	20.6	31.0	18.1
Average...		6,800	38.5	61.0	41.2	20.4	30.5	22.9

In table 7 are included results of tests with eggplants and cabbages in which various combinations of red and yellow copper oxide, Vasco 4, and zinc oxide were used to treat the seed and soil. Yellow copper oxide and Vasco 4 applied to the soil surface gave about the same increases in stands of eggplants by controlling post-emergence damping-off. With cabbages Vasco 4 and zinc oxide on the seed and soil were about equally efficient in increasing stands and were superior to the combination of red copper oxide on the seed and yellow copper oxide on the soil.

In table 8 are included results of tests with seeds of various ornamental plants. Red copper oxide, yellow copper oxide, Vasco 4, zinc oxide, and Dubay 1286a were used to treat the seed. The yellow copper oxide gave the best results with Calendula, Zinnia, Centaurea, Pansy, and Cosmos. Zinc oxide gave the best results with Salvia. In general, red copper oxide gave better results than Vasco 4, which in turn was superior to zinc oxide. Dubay 1286a did not seem to be as efficient as the copper oxides.

TABLE 5. RESULTS OF TESTS COMPARING MERCK'S RED COPPER OXIDE AND METROX. BOTH USED TO TREAT THE SEED.

Soil type	No. of tests	Total number seed	PER CENT EMERGENCE			PER CENT STAND		
			Check	Merck's red copper oxide*	Metrox	Check	Merck's red copper oxide	Metrox
TOMATOES								
Sharkey.......	3	2,500	59.1	69.0	62.6	56.2	64.8	59.8
Olivier.........	3	2,500	26.1	75.0	70.4	23.5	71.9	66.3
Average...		5,000	42.6	72.0	66.5	39.9	68.4	63.0
BELL PEPPERS								
Sharkey.......	3	2,500	59.3	61.4	65.0	56.2	56.9	63.8
Olivier.........	3	2,500	52.7	73.4	71.6	43.7	66.6	71.2
Average...		5,000	56.0	67.4	68.3	50.0	61.8	67.5
EGGPLANTS								
Sharkey.......	3	2,500	30.7	48.8	48.1	22.0	34.3	35.6
Olivier.........	3	2,500	34.4	53.8	51.8	20.5	32.7	31.0
Average...		5,000	32.6	51.3	50.0	21.3	33.5	33.3

*Merck's red copper oxide obtained from the Merck Chemical Co. and Metrox from Metals Refining Co., Hammond, Indiana.

In table 9 are included results of tests in which Spergon was compared with yellow copper oxide. In general, Spergon did not give as satisfactory results as did the yellow copper oxide. The emergence was in most cases satisfactory but the final stands were lower.

In table 10 are included results of seed treatment tests with ornamental plants in which yellow copper oxide was compared with some of the organic mercury compounds, Ceresan, New Improved Ceresan, and New Improved Semesan, Jr., New Improved Ceresan was too toxic to be used at full strength. The New Improved Semesan, Jr., and the 2% Ceresan were also toxic in some cases.

TABLE 6. RESULTS OF TESTS WITH RED COPPER OXIDE AND ZINC OXIDE. THE COPPER OXIDE WAS USED TO TREAT THE SEED AND THE ZINC OXIDE AS A SOIL DRESSING.

Soil type	No. of tests	Total number seed	PER CENT EMERGENCE			PER CENT STAND		
			Check	Red copper oxide	Red copper oxide and zinc oxide	Check	Red copper oxide	Red copper oxide and zinc oxide
TOMATOES								
Sharkey........	6	5,500	43.5	81.1	77.7	36.6	73.8	76.9
Olivier..........	6	5,500	37.6	79.6	76.3	35.7	77.1	75.5
Average...		11,000	40.6	80.4	77.0	36.2	75.5	76.2
BELL PEPPERS								
Sharkey........	6	5,500	60.1	74.9	76.2	52.7	70.9	75.8
Olivier..........	6	5,500	58.8	66.9	69.0	53.4	65.8	68.8
Average...		11,000	59.5	70.9	72.6	53.0	68.4	72.3
EGGPLANTS								
Sharkey........	5	4,600	44.9	67.4	69.9	21.3	41.3	60.8
Olivier..........	5	4,600	42.4	68.6	66.5	20.3	53.9	62.4
Average...		9,200	43.7	68.0	68.2	20.8	47.6	61.6

TABLE 7. RESULTS OF TESTS WITH RED AND YELLOW COPPER OXDES, VASCO 4, AND ZINC OXIDE (PER CENT STAND).

	Number of seed	Check	Red copper oxide on seed, yellow copper oxide on soil	Red Copper oxide on seed, Vasco 4 on soil	Vasco 4 on seed and on soil	Zinc oxide on seed and on soil
EGGPLANT						
	1,800	50.0	72.8	69.6	....	....
	2,400	39.3	73.3	73.8	....	....
Average...........	4,200	44.7	73.1	71.7	....	....
CABBAGE						
	1,200	17.3	34.9	....	64.9	71.0
	300	67.7	79.7	80.7	88.0	87.0
Average...........	1,500	42.5	57.3	....	76.5	79.0

TABLE 8. RESULTS OF SEED TREATMENT WITH VARIOUS ORNAMENTAL PLANTS

Plant	Number of tests	Total Number seed	Check	Red copper oxide	Yellow copper oxide	Vasco 4	Zinc oxide	Dubay 1286a
PER CENT EMERGENCE								
Calendula	5	2,000	20.8	51.6	57.6	53.0	49.4	49.3
Zinnia	3	1,000	23.4	55.1	60.6	43.9	32.7	62.0
Salvia	3	1,100	10.6	17.8	15.8	18.0	20.6	....
Centaurea	2	800	3.0	53.4	58.8	10.2	7.5	37.4
Pansy	2	800	6.6	16.8	30.0	12.8	....	....
Cosmos	2	700	35.7	55.4	59.1	48.1	44.0	49.1
Snapdragons	4	1,600	25.3	....	25.1	....	24.5	14.4
PER CENT STAND								
Calendula	5	2,000	16.1	34.1	45.7	40.0	32.8	34.6
Zinnia	3	1,000	17.6	52.9	61.0	35.8	25.9	56.6
Salvia	3	1,100	9.1	15.5	15.4	15.4	20.2	....
Centaurea	2	800	0.1	45.6	51.9	6.6	5.1	5.0
Pansy	2	800	4.9	11.9	19.9	11.5	....	....
Cosmos	2	700	32.9	52.4	57.1	44.1	37.6	44.4
Snapdragon	4	1,600	24.3	....	22.3	....	22.6	14.2

TABLE 9. RESULTS OF SEED TREATMENT TESTS WITH SEED OF ORNAMENTAL PLANTS COMPARING SPERGON WITH YELLOW COPPER OXIDE.

Plant	Number of tests	Total number of seed	Check	Yellow copper oxide	Spergon
EMERGENCE					
Calendula	3	1,200	16.3	60.8	51.5
Zinnia	2	600	25.5	64.7	65.2
Salvia	3	1,100	10.6	15.8	18.0
Centaurea	2	800	3.0	58.8	21.9
Pansy	1	400	3.5	33.5	7.8
Cosmos	2	700	35.7	59.1	53.1
STAND					
Calendula	3	1,200	11.2	42.2	27.5
Zinnia	2	600	17.3	60.2	52.7
Salvia	3	1,100	9.1	15.5	15.3
Centaurea	2	800	2.0	51.9	29.0
Pansy	1	400	1.8	15.0	4.3
Cosmos	2	700	32.9	57.1	47.0

TABLE 10. Results of Seed Treatment Tests With Seed of Ornamental Plants Comparing Some of the Organic Mercury Compounds With Yellow Copper Oxide.

Plant	Number of seed	Check	Yellow copper oxide	New Improved Ceresan	New Improved Semesan Jr.	Ceresan
EMERGENCE						
Pansy	400	9.8	26.5	....	9.0	15.3
Calendula	400	29.3	56.5	0.5	13.5	6.3
Zinnia	400	18.0	62.3	0.3	50.8	41.0
Nasturtium	400	56.5	62.3	0.0	53.0	56.3
Snapdragon	400	28.3	35.0	16.3	41.5	42.5
Snapdragon	400	50.8	36.8	1.3	34.3	5.5
STAND						
Pansy	400	8.0	24.8	....	9.0	14.5
Calendula	400	26.5	53.5	0.5	12.8	4.8
Zinnia	400	18.0	62.3	0.3	50.8	41.0
Nasturtium	400	56.5	62.3	0.0	53.0	56.3
Snapdragon	400	28.3	35.0	16.3	41.5	42.5
Snapdragon	400	50.8	36.8	1.2	34.3	5.5

SUMMARY

Results of studies over a period of seven years on the control of damping-off under Louisiana conditions by the use of seed and soil treatments are presented. Sharkey and Olivier soils were used in the tests.

Red copper oxide when used to treat the seed was found to be the most practical and effective material to control damping-off of tomatoes and bell peppers. Red copper oxide on the seed was not sufficient to control post-emergence damping-off of eggplants. Vasco 4 and zinc oxide gave the best results with cabbages. Red copper oxide was toxic to cabbages.

The commercial formaldehyde dusts when used to treat the soil were about as efficient as red copper oxide on the seed with tomatoes and bell peppers but were of little value with eggplants.

Zinc oxide, Vasco 4, and yellow copper oxide when used to treat the soil surface were about equally effective in controlling post-emergence damping-off of eggplants.

Concentrated formaldehyde solution (40% formaldehyde) diluted in 5 or 6 times its volume of water was effective in controlling damping-off of tomatoes, peppers, and eggplants, but was toxic to eggplants in the Olivier soil.

With seed of ornamental plants, yellow copper oxide was the most efficient, followed by red copper oxide, Vasco 4, and zinc oxide in the order named. The organic mercury dusts were often toxic when applied full strength.

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RECOMMENDATIONS

The following recommendations have been found by the Louisiana Agricultural Experiment Station to be satisfactory in controlling damping-off.

Cabbage: Treat the seed with Vasco 4 or zinc oxide (Treatment 2). If plants begin to damp-off after coming up apply Vasco 4 or zinc oxide on the soil (Treatment 4). Do not use red or yellow copper oxide on cabbage seed as these compounds are often toxic.

Eggplants: Treat the seed with red copper oxide or yellow copper oxide (Treatment 1). When the plants begin to break through the soil *always* water the plants with a suspension of red or yellow copper oxide in water (Treatment 3) or apply either Vasco 4 or zinc oxide as a soil cover (Treatment 4).

Peppers: Treat the seed with red copper oxide or yellow copper oxide (Treatment 1). Usually seed treatment is enough, but if the plants damp-off after coming up, either water the soil with a red or yellow copper oxide suspension in water (Treatment 3) or apply Vasco 4 or zinc oxide to the soil (Treatment 4).

Tomatoes: Treat the seed with red copper oxide or yellow copper oxide (Treatment 1). The seed treatment is usually enough but if plants damp-off after coming up, water the soil with a red or yellow copper oxide suspension in water (Treatment 3) or apply Vasco 4 or zinc oxide to the soil (Treatment 4).

Ornamental Plants: Treat the seed with red copper oxide or yellow copper oxide (Treatment 1). Results indicate the yellow copper oxide to be somewhat better. This treatment has given satisfactory results with the following:

Calendula
Centaurea
Cosmos
Pansy
Salvia
Zinnia

Results at other experiment stations in the United States indicate that seed treatment is of value with many other plants than those given above. The plants and the treatments recommended are given below:

Red Copper Oxide (Treatment 1).

Vegetables:

Beets
Carrots
Cucumbers
Endive
Escarole
Lettuce
Muskmelon
Pea
Pumpkin
Romaine
Spinach
Squash
Swiss chard
Watermelon

Ornamentals:

Anchusa
Arabas
Arbor vitae
China aster
Cobeae
Cockscomb
Dahlia
Digitalis
Eschscholtzia
Gypsophila
Helichrysum
Heliopsis
Hollyhock
Leptosiphon
Lupine
Marigold (African)
Marigold (French)
Mesembryanthum
Nasturtium
Penstemon
Phlox drummondii
Pyrethrum
Salpiglossis
Sweet Pea
Venidium

Vasco 4 or Zinc Oxide (Treatment 2).

Cauliflower
Kale
Kohlrabi
Radish
Turnip

TREATMENTS RECOMMENDED

Treatment 1

Seed treatment with red copper oxide or yellow copper oxide. Either of these compounds should be applied to the seed at the rate of 1½ level teaspoonful per pound of small seed and ½ teaspoonful per pound of large seed. To treat, place the dust and seed in a tight container and shake until all the seed are well-covered. For small quantities of seed, use only enough dust to coat each seed. If too much dust is present the seed should be screened to remove the excess. If the treated seed are to be used in a drill, ½ as much graphite by weight as copper oxide should be added at the time the seed are treated. This prevents the seed clogging the drill.

Red copper oxide is frequently sold under the trade name of *Cuprocide.* Frequently the name *Yellow Cuprocide* is used for the yellow copper oxide.

Treatment 2

Seed treatment with Vasco 4 or zinc oxide. Either of these compounds should be applied to the seed at the rate of two level teaspoonfuls to the pound of seed. To treat, place the dust and seed in a tight container and shake until all the seed are well-covered. If the seed are to be used in a drill add ½ as much graphite as dust when the seed are treated. The seed should be screened after the treatment to remove any excess dust.

Apparently, due to war priorities, Vasco 4 is no longer manufactured. At present, however, there may be some still in the hands of dealers.

Treatment 3

Soil treatment with red copper oxide or yellow copper oxide. Add 1¼ oz. (6 level teaspoonfuls) of either copper oxide to one gallon of water and stir thoroughly. This should be sprinkled on the surface of the soil when the young plants are emerging. This treatment may be repeated if the plants begin to damp-off.

Treatment 4

Soil treatment with Vasco 4 or zinc oxide. Either of these substances should be applied to the soil at the time the young plants are emerging. Enough should be applied to thoroughly cover the soil surface. Either can be applied by punching holes through the bottom of a can and shaking the dust through the holes. Two ounces of the dust will usually be enough to cover about 3 square feet of soil surface. Care should be taken not to break the layer of the chemical on the surface of the soil.

Zinc oxide can be obtained under such trade names as Zinc White, Paint White, or Leafox 200.

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NUMBER 3

ASSEMBLED BY

C. O. EDDY

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS

W. G. TAGGART, *Director*

ENTOMOLOGICAL PROGRESS

(NUMBER 3)

C. O. Eddy
Louisiana Agricultural Experiment Station

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Cotton Flea Hopper Control in Louisiana, 1940

I. J. Becnel
Louisiana Agricultural Experiment Station[1]

The cotton flea hopper, *Psallus seriatus* Reuter, occurred in sufficient numbers to cause injury to young cotton on several farms in Caddo and Bossier Parishes, Louisiana, during the summer of 1940. Infestations in the areas under observation were moderately severe. However, the infestations in general throughout the Red River Valley were of practically no significance. Counts made at several locations along the Red River Valley revealed predominantly low infestations.

The fields selected for the experiments in 1940 were located in Bossier Parish about three miles north of Bossier City, Louisiana.[2] The experimental blocks were located in fields adjacent to the Red River levee. The levee is of importance here in that it affords good conditions for overwintering flea hopper eggs and numerous early season wild host plants, especially evening primrose and young croton.

The work was a continuation of similar field control experiments conducted in 1938 and 1939. The insecticides used were not identical to those used in previous experiments, but the general manner in which the project was handled was similar to that of 1938-1939. (Becnel 1940)

METHODS:

The randomized blocks method of plot arrangement using 24 plots in Experiment I and 30 plots in Experiment II were used in tests conducted for insecticidal control of the cotton flea hopper. Each plot consisted of 1/30 acre and was bordered by 10 feet of untreated buffers.

The plots received the following treatments: Experiment I—"A" untreated, "B" 325 mesh dusting sulphur, "C" a combination of 325 mesh dusting sulphur and calcium arsenate (2:1), and "D" a dust containing 93% 325 mesh dusting sulphur and 7% Paris green. Experiment II—"A" untreated, "B" 325 mesh dusting sulphur, "C" a combination of 325 mesh dusting sulphur and calcium arsenate (2:1), "D" a combination dust containing ½ 325 mesh dusting sulphur and ½ (nicotine sulphate, hydrated lime dust, 4% nicotine) and "E" a combination dust containing two parts of 325 mesh dusting sulphur and one part of 50% lead arsenate, 50% cryolite mixture.

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[1] The author was assisted in the field by H. S. Mayeux, and J. S. Roussel, Entomology students at Louisiana State University.

[2] The author wishes to acknowledge the assistance and interest of the personnel of the Beene Planting Corporation on whose place the experiments were conducted.

The plots for treatment in Experiment I were dusted in the early mornings of June 13, June 20, June 27, July 4 and July 11, 1940 at the approximate rate of 12 pounds per acre (Table 1). The plots in Experiment II were dusted in the early mornings of June 25, July 2, July 9, July 26, 1940. Individual hand dust guns were used for each insecticide so that accurate weight records of dusts applied could be obtained. These records are given in Table 1. Each treatment was effective since there was no rain within 24 hours following any application. Moderate boll worm and boll weevil infestations necessitated the use of one application of calcium arsenate and one of calgreen on August 13, and August 20, respectively, on all plots of both experiments. These applications were made to protect the crop that had "set" through the flea hopper period.

TABLE 1—Average Amount of Insecticide Used Per Acre Per Application and Total Amount Per Acre Used During Dusting Period.

	Experiment I			Experiment II	
	Average	Total		Average	Total
B	13.62 lbs.	68.1 lbs.	B	13.56 lbs.	54.24 lbs.
C	12.24 lbs.	61.2 lbs.	C	13.29 lbs.	53.16 lbs.
D	12.30 lbs.	61.5 lbs.	D	12.99 lbs.	51.96 lbs.
			E	12.87 lbs.	51.48 lbs.

The infestation counts were taken on 100 consecutive terminal buds on the third and fourth rows of each plot (Gaines 1937). The initial counts for Experiment I were made on June 12 and subsequent counts were made on June 18, June 22, June 27, July 2, July 8, July 12, July 17, July 25 and August 1. The initial counts for Experiment II were made on June 25 and subsequent counts were made on June 29, July 4, July 9, July 13, July 19, July 25, July 29, and August 5. Separate records of nymphal and adult infestations were kept for each count.

The boll weevil and boll worm infestations were checked occasionally throughout the period of the experiments. Infestations were not significant until August 13 at which time it was necessary to use control measure.

Bloom counts were made at weekly intervals on both experiments on all plants of the fourth, fifth, and sixth rows. These counts to some extent revealed the effectiveness of the materials used in preventing injury to the small squares by the flea hopper. The bloom counts were followed by form counts made on 10 plants on each of the fourth, fifth, and sixth rows of each plot. These counts consisted of all bolls, squares, and blooms found on the 30 plants of each plot.

Yield records were made on carefully measured 1/100 acre areas of each plot. Three pickings of seed cotton were made on each experiment and the accurate weight picked on each plot was obtained. The total number of stalks included in the measured area of each plot was recorded at the time of the first picking.

RESULTS:

The average number of nymphs and adults found during the dates included in the dusting period of each experiment was used in the analysis of variance for the effectiveness of the insecticides in reducing infestations. The results of these counts and the average number of nymphs and adult flea hoppers recorded at the initial infestation counts are given in Table 2.

TABLE 2—SHOWING TOTAL INITIAL INFESTATION PER 100 TERMINALS, AND AVERAGE INFESTATION OF NYMPHS AND ADULTS DURING DUSTING PERIOD.

Experiment I
(Dusting Period Included June 18 to July 12 Inclusive)

Treatment	Initial Infestation	Average No. of Nymphs	Average No. of Adults
A-Untreated	154.66	49.49	15.44
B-325 Mesh sulphur	155.50	18.16	9.13
C-325 Mesh sulphur calcium arsenate (2:1)	160.66	21.19	6.74
D-325 Mesh sulphur 93% Paris green 7%	165.00	16.44	5.47
Minimum significant difference			
5% Level	......	7.155	3.049
1% Level	......	9.896	4.217

Experiment II
(Dusting Period Included June 29 to July 29 Inclusive)

Treatment	Initial Infestation	Average No. of Nymphs	Average No. of Adults
A-Untreated	74.83	19.54	9.61
B-325 Mesh sulphur	84.33	8.13	4.54
C-325 Mesh sulphur Calcium arsenate (2:1)	72.66	6.61	3.83
D-½, 325 Mesh sulphur and ½ (nicotine sulphate, lime dust, 4% nicotine)	78.00	10.65	4.99
E-⅔, 325 Mesh sulphur ⅓ 50% cryolite, 50% lead arsenate mixture	77.33	7.30	4.51
Minimum Significant Difference			
5% Level	......	1.745	1.574
1% Level	......	2.381	2.147

From Table 2 it is seen that in Experiment I each of the insecticides used resulted in highly significant reduction of nymphal infestation as compared to the untreated plots. However, there were no significant differences between treatments B, C, and D. The reductions of adult infestations for treatments B, C, and D were highly significant as compared to the untreated plots. The reduced adult infestation for treatment D was significant over treatment B. However, the mean differences between treatments B-C, and C-D were not significant.

The insecticides used in Experiment II resulted in highly significant reductions of nymphal infestation as compared to the untreated plots. There were no significant differences between treatment B, C, and E, but each treatment was highly significant over treatment D. The reductions in adult infestations as compared to the untreated plots were highly significant for all treatments. However, the differences between treatments were not significant.

The results of the bloom counts are given in Table 3. These counts included only the "white blooms" found on all plants on the 4th, 5th, and 6th rows of each plot.

TABLE 3—TOTAL NUMBER OF "WHITE BLOOMS" FOUND ON THE 4TH, 5TH, AND 6TH ROWS OF THE SIX PLOTS INCLUDED IN EACH TREATMENT

Experiment I

Treatment	7/4	7/11	7/18	7/25	8/1	8/5	8/12	8/22	Average
A	22	15	107	335	449	425	568	352	284.12
B	42	34	195	495	864	681	598	289	399.75
C	27	35	199	498	952	809	723	280	440.37
D	19	26	192	439	818	738	612	281	390.62

Experiment II

Treatment	7/9	7/16	7/25	7/29	8/2	8/6	8/13	8/20	Average
A	48	60	214	494	443	407	447	200	289.1
B	61	73	271	716	660	537	669	267	406.7
C	83	82	276	776	823	707	636	243	453.2
D	85	67	262	581	581	483	555	298	364.0
E	69	72	295	760	836	589	611	266	437.2

The form counts were made at weekly intervals from July 26 to Sept. 6 for Experiment I and from August 7 to September 4 for Experiment II. The final counts for Experiment I made on September 6 resulted in the following increase in number of bolls per 30 stalks over the untreated plots: B, 358; C, 302; D, 333. The increase in number of bolls per 30 stalks for the final counts on Experiment II made on September 4 was: B, 190; C, 288; D, 141; and E, 264.

From Table 4 it is seen that the only significant increase in seed cotton was obtained in the plots receiving treatment C in Experiment I. The increase was highly significant over the untreated plots and significant over the B plots. All other mean differences in yields were not significant. The results of the stalk counts made at the time of the first picking showed that the stands in the measured areas were remarkably uniform.

TABLE 4—Means Yields of Seed Cotton (1/100 Acre) Pounds

Experiment I		Experiment II	
Treatment	Mean Yield Seed Cotton, 1/100 acre	Treatment	Mean Yield Seed Cotton, 1/100 acre
A	13.091	A	14.825
B	14.775	B	15.525
C	17.741	C	16.600
D	15.566	D	14.716
		E	16.125
Minimum Significant Difference			
5% level	2.801		F Value for treatments Not Significant
1% level	3.873		

Discussion of Results:

The initial infestations of flea hoppers were considerably higher for Experiment I than for Experiment II. Counts made one day previous to the first treatments resulted in infestations approximately 50% higher for Experiment I. No doubt the squares in Experiment I were being "blasted" more severely at the beginning of the tests. The average infestations during the dusting period on the untreated plots of Experiment I showed an increase of 29.95 nymphs and 5.83 adults per 100 terminals as compared to corresponding counts for Experiment II. Since the dusting period included about one month, it is evident that the untreated plants in Experiment I were subjected to heavier flea hopper infestations and therefore the protected plants were expected to show reduced "blasting" of squares.

Inspection of Table 2 shows that the flea hopper infestations of adults and nymphs were effectively reduced by every treatment. The treatments used in Experiment I were equally effective in reducing the infestations of nymphs. Treatment D was significant over treatment B in reducing the adult infestations. The other treatments were equally effective. It was expected that treatments C and D would be significant over treatment B in reducing the adult infestations. Ewing and McGarr (1938) found that a mixture of sulphur and calcium arsenate (2:1) gave better control where a large proportion of the flea hoppers were adults. The treatments used in Experiment II resulted in highly significant reductions in infestations of nymphs for B, C, and E over D. All treatments were equally effective in reducing adult infestations. Perhaps the nicotine and lime contained in the D treatment acted as a repellent and caused the adults to move out of the D plots. Observations made immediately following the applications of treatment D revealed a noticeable movement of adult flea hoppers.

The bloom counts, Table 3, shows that the plants on the untreated plots of Experiment II bloomed more freely than corresponding plants on Experiment I. This indicates that the small squares on Experiment I were more severely "blasted." Counts made during the early period of the tests showed that plants on Experiment II produced greater numbers of blooms than corresponding plants on Experiment I.

Plants on the treated plots of Experiment I contained greater increases of bolls over the untreated plots, thereby indicating to some extent the reduced "blasting" of squares on the treated plots. Infestations on the untreated plots were high throughout the dusting period and, as stated before, the "blasting" of squares was severe.

From Tables 2 and 4 it is apparent that moderate flea hopper infestations early in the growing season did not injure the squares on Experiment II to the extent that the injury was carried through to harvest. There is no doubt but that numerous squares were "blasted"; however, it is evident that the majority of plants overcame the early set back. The early infestations were moderate but dropped rather abruptly on the untreated blocks and the early damage was apparently overcome by the vigorously growing plants. The untreated plots of Experiment I were subjected to heavy flea hopper infestations throughout the dusting period, whereas the infestations in the treated plots remained extremely low. Increased production of seed cotton by the treated plants indicate that flea hopper injury to the untreated plants was sufficient to affect the yield. According to these results it is apparent that average flea hopper infestations of 19.5 nymphs and 9.6 adults per 100 terminals occurring through the month of July did not injure the growing plants sufficiently so that the injury was reflected in the yield.

The bottom crop on the untreated plots was obviously less than that of the treated plots. This was especially true in Experiment I. It is the author's opinion that the reduced bottom crop was a result of the early flea hopper injury.

The plots receiving treatment C in Experiment I resulted in highly significant yields of seed cotton as compared to the untreated plots and significant yields as compared to plots receiving treatment B. The yield of the D plots showed a noticeable increase over the untreated plots, but the increase was not significant. All treated plots, with the exception of D, in Experiment II resulted in slight increases in yield as compared to the check. However, these increases were not significant.

SUMMARY:

The randomized blocks arrangement was used in tests for cotton flea hopper control in Louisiana. One experiment consisted of 24 plots, the other 30 plots of 1/30 acre each. Untreated buffers of 10 feet bordered each plot. Infestation counts consisted of the number of nymphs and adults per 100 consecutive terminals in each plot. Bloom counts included all white blooms found on the fourth, fifth, and sixth rows of each plot. Form counts included total number of squares, blooms, and bolls on 30 plants on each plot. Accurate records of poison used were made. Yield records were obtained on measured 1/100 acre areas of each plot.

Reductions of nymphal infestations for the 24 plot experiment were highly significant on the plots treated with 325 mesh sulphur; 325 mesh sulphur, calcium arsenate (2:1); and 93% 325 mesh sulphur, 7% Paris green. These treatments also resulted in highly significant reduction of adult infestation as compared to the untreated plots. The plots treated with the mixture of 93% calcium arsenate, 7% Paris green reduced the adult infestation significantly as compared to the plots treated with 325 mesh sulphur.

Reduction of nymphal infestation for the 30 plot experiment were highly significant on the plots treated with 325 mesh sulphur; 325 mesh sulphur, calcium arsenate (2:1), ½ 325 mesh sulphur, ½ (nicotine sulphate-lime dust, 4% nicotine); and 2/3 325 mesh sulphur, 1/3 50% cryolite and 50% lead arsenate mixtures. Every treatment was highly significant over the dust containing sulphur, lime and nicotine sulfate. The reductions in adult infestation as compared to the untreated plots were highly significant for all treatments.

Untreated plants on the 30 plot experiment produced a greater number of blooms than untreated plants on the 24 plot experiment. Greater flea hopper infestations on the latter experiment apparently "blasted" a higher percentage of squares.

The only significant yield records were obtained on the 24 plot experiment. Plots dusted with sulphur and calcium arsenate (2:1) resulted in highly significant yields when compared to untreated plots, and significant yields when compared to the sulphur treated plots. The significant increase in yields could be attributed to the fact that throughout the dusting period of the two experiments the untreated plants of the 24 plot experiment were subjected to much heavier flea hopper infestations.

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Cryolite As An Insecticide

No. 2

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In the research program of the Louisiana Agricultural Experiment Station, which has been directed towards the finding of an insect poison which will not injure tender foliage, fruits, and vegetables, cryolite continues to be one of the most promising materials for the control of insects that feed by chewing on plant tissues.

In former publications numerous uses for this poison have been indicated.* During the last year through cooperative work with the Louisiana Agricultural Extension Service and with the assistance of manufacturers and sales agencies, practical applications of these recommendations have been made in a number of parts of the State with success. Since cryolite continues to be effective in the control of these insects and since it has been so practically applied in a number of parts of the State, it appears that it is destined to become a standard insecticide in Louisiana, just as calcium arsenate, lead arsenate, Paris green and derris.

These insecticides can serve the growers, farmers, and gardeners of Louisiana, in that each one is best adapted to the control of certain insects, or for use on certain plants, or in combinations with certain fungicides and diluents. Then too, each of these insecticides, in turn, fails to be satisfactory in the control of numerous insects or cannot be used on certain plants. With this group of four insecticides for chewing insects to choose from, growers will be able to control a much greater number of chewing insects on a greater number of plants.

Experiments during the last year have been directed particularly to combinations in which fluorine compounds may be used successfully in either sprays or dusts. For instance—a number of the fluorine compounds are not compatible with basic copper sulphate nor with Bordeaux mixture. Experiments at Baton Rouge have shown that cryolite is not compatible with a number of the insoluble copper compounds, including such materials as Bordeaux mixture, but that it is compatible with a number of insoluble copper compounds such as basic copper sulphate and copper oxide. In general, cryolite and the other fluorine compounds can not be used successfully with fungicides or with diluents that contain lime or that are alkaline in nature.

One of the most promising fungicide and insecticide combinations is cryolite dust mixture No. 1, which is as follows:

Cryolite Dust Mixture No. 1

33%	Cryolite
18%	Basic copper sulphate (7% metallic copper)
10%	Flour
39%	Clay or Talc
100%	

Cryolite Dust Mixture No. 1 has been used by a few growers and in plots at Baton Rouge for four years for the control of the tomato fruit worm. The fungicide was added to control the diseases that are checked or controlled by the copper fungicides. It also allowed the plant to grow much more normally and produce better and larger fruit than the lead arsenate Bordeaux sprays which were in common use. The first mixture gave two or three times better control of the pickle worm than did the lead arsenate-Bordeaux sprays.

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* The first number in this series appears in *Entomological Progress* Number 2, *Louisiana Bulletin* No. 323, June, 1940.

In the experiments on tomatoes during the last year, Cryolite Dust Mixture No. 2 has given somewhat better control of the tomato fruit worm than Cryolite Dust Mixture No. 1. Experiments and practical experiences during the next few years will probably show what the most profitable and most effective dust mixture will be on tomatoes.

Cryolite Dust Mixture No. 2

50%	Cryolite
18%	Basic copper sulphate
32%	Inert diluent
100%	

Cryolite also has been used successfully with sulphur, and with mixtures of insoluble copper fungicides and sulphur. The growers of ornamental plants, in particular, are finding that this combination of cryolite with basic copper sulphate and sulphur is useful. For instance, 33% of cryolite can be mixed with the 90-10 sulphur-basic copper sulphate mixture in order to control the diseases and chewing insects of roses. In case sucking insects are a factor, Black Leaf 10 or derris may be added to this combination.

In the production of soybeans, in the experiments at Baton Rouge and in practical field control in Madison Parish, cryolite has given worthwhile control of the several beetles that attack this crop. These beetles include the bean leaf beetle, the banded diabrotica, the spotted diabrotica, and the grape colaspis. These findings are in addition to those reported earlier in which excellent control has been secured of the soy bean caterpillar on this crop. In future plantings, to increase the production of soy bean oil in the State, it now seems imperative that the control of the soy bean caterpillar and the several beetles be taken into account and actual plans made for dusting of this crop each year.

For several years our experiments have been conducted in an attempt to adapt cryolite to the control of the several worms that attack the late crop of corn, which is so badly attacked in the growing bud by larvae of the corn earworm and the grass worm. Experiments this year showed that cryolite was very toxic to this plant. The effects were so serious that in all cases where more than one application of cryolite was applied the plants were badly burned and stunted. Cryolite sprays burned the corn much more severely than did the dust. It thus seems very improbable that cryolite can ever be adapted to any dust or spray program for the control of pests that attack the growing terminal of corn. Experiments this year did indicate, however, that considerable control of these two insects may be secured by the use of lead arsenate, applied at weekly or ten-day intervals during the period when the attacks are severe and the corn is small.

Notes on the Biology and Seasonal History of the Sweet Potato Weevil in Louisiana

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The commercial sweet potato growing area of Louisiana suffers annually from the attacks of the sweet potato weevil, an insect which takes a very serious toll from the crop and influences the growing and moving of the plant, in that the area infested is subject to stringent quarantine regulations.* Of course, the rest of the State is subjected to a threat from this pest since there is a continuous fight in effect to prevent the extension of the insect from the Central Louisiana potato-growing area and an eradication program by the Louisiana State Department of Agriculture to eliminate alternate host plants in other areas. This pest is of widespread importance in that it affects the entire sweet potato growing belt along the Gulf Coast area from Texas to Florida.

In 1918 a systematic study of this insect was begun by the Bureau of Entomology in the United States Department of Agriculture, and the Agricultural forces of the weevil infested states. The Louisiana Agricultural Experiment Station began in 1937 a detailed study of the life history of the sweet potato weevil. This study by the Louisiana Agricultural Experiment Station is still in progress, and a summary of the biological work accomplished is given below:

The adult sweet potato weevil resembles a large ant. It is approximately one-fourth inch long, is dark blue on the head and abdomen, brick red on the thorax, and with brick red legs.

The adult female weevil laid its eggs in small holes which it punctured in the plants near the crown, in the stems, and in the potatoes. After an egg was laid it was sealed over with a waxy material by the mother weevil. It was ascertained from numerous examinations that unless the potatoes under ground were exposed by soil cracking or other means, they were relatively safe from weevil attack. However, it was found that approximately five percent of the root infestations occurred from larvae which had tunneled their way down through the crown and into the potatoes below.

The incubation period of the eggs was about one week. The small grubs or larvae fed in the vines or potatoes for two or three weeks before they were fully grown. At this time, the larvae changed into the pupal stage and remained in the pupal stage about one week. During this stage, the weevil was inactive and the body form entirely different from that of the larva, in that it now resembled the adult beetle, but was soft and white. The adult weevils shed their pupal skins and crawled out as mature insects, ready to start feeding again and depositing eggs for another generation.

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* The value of the 1939 sweet potato crop in Louisiana was $4,000,000. Agricultural Statistics, 1940.

Caged male weevils in the laboratory lived an average of 72 days and females lived an average of 85 days. However, one male under observation lived 416 days, and several others lived over 300 days.

During the warmer periods of the year, it required approximately one month for the insect to develop from the egg stage to the adult weevil. There may occur as many as six to eight generations of weevils in a year.

The female weevil, after mating, commenced to lay eggs, and it was found that the average number of eggs laid per female was 119. The maximum number of eggs laid by any female in laboratory studies was 319. There was an average preoviposition period of about 15 days, after which the weevils commenced to lay eggs and continued to oviposit about 62 days, then stopped for approximately 10 days before death. Oviposition occurred during every month of the year; however, it began to decline in September and October, and from November until March oviposition was negligible. In April it was revived and increased as the season advanced. Egg laying, as well as feeding, took place largely on dark, cloudy days and at night.

During the summer the eggs hatched in about seven days; whereas in the fall it required an average of 18 days for incubation, and in the winter the eggs usually did not hatch under three months' time.

The newly hatched larvae in sweet potatoes began feeding just under the skin and ate deeper as they grew. When they were in the stem or crown they ate their way to the center of the plant and developed there. There were three larval instars, the grubs shedding their skin twice before reaching the pupal stage. A detailed study of individuals revealed that in summer 18 days were required for the larva to reach maturity; 27 to 50 days for the same development in the fall, and about 130 days in the winter. During very cold days in winter, larvae under observation failed to feed. This fact evidently accounted for the slow development during the winter. Development did not actually cease during the winter; it was merely retarded.

Duration in the pupal form varied considerably. It was found in summer that this stage of development lasted about six days; whereas in the fall and winter the insects remained as pupae as much as 30 days.

The pre-emergence period of the weevils lasted seven days in the summer, to as much as 35 days in the winter. During this period the weevils had already shed their pupal skins, but the body had not become fully hardened. When emergence occurred, however, the body wall had fully hardened, thus giving the insect sufficient protection in its new environment.

Activity of the adult sweet potato weevil was closely related to the temperature. Above 70° F. the weevils fed and oviposited abundantly. Below 70° F. feeding and oviposition declined sharply. Below 60° F. oviposition ceased entirely and at 47° F. feeding ceased entirely. At 40° F. the weevil was completely inactive. Laboratory tests showed that a seven day exposure at 30° F. killed adult weevils out of the potato. A 15 day exposure at 30° F. was necessary to kill larvae in the potato, and 21 days at the same temperature to kill the pupae.

Results of examination of potatoes left in the fields over winter showed that under Louisiana conditions only a small percentage of the weevils are destroyed by low temperatures. The temperature often drops low enough to kill both larvae and adult weevils, but it does not remain so for a sufficient length of time to cause a high mortality. The average kill from cold during a normal winter runs about 25 per cent of the over-wintering stages; however, during an unusually cold winter such as that of 1939-1940, as much as 40 to 50 per cent of the weevils were found to have died. Well over 50 per cent of the over-wintering stages in the field may be expected to survive a normal winter in Louisiana.

An intensive field study was made during 1940 of the sweet potato weevil to determine at what time of the growing period the weevil was present in greatest numbers and in what stage of development. This was accomplished by examination at regular intervals of 100 hills of potatoes, selected at random, in a two-acre sweet potato field. The first examination was made on the twenty-first of June and at weekly intervals thereafter through August 21, when examinations were made monthly. The examination consisted in digging plants and bringing them into the laboratory where every part of the plant, above and below surface, was examined under a binocular microscope for eggs. The vines and roots were then split and examined for other stages.

On June 21, the date of the first examination, the plants were small, having been set in the field but 11 days; however, eggs were found and one first instar larva. The following week second instar larvae were found, and on July 9, or two weeks after the first eggs were found, third instar larvae were present. The first pupae were found on July 16, and at the end of four weeks adults were emerging. The greatest number of larvae were found in September and October. The peak in adult population occurred in late October and the greatest number of eggs were found in the middle of November. During the month of December all stages of the weevil were found in the roots; the tops of the plants having been killed in November. The number of stages found in December was considerably low as compared to October and November.

It is interesting to note the percentage of stages found above and below ground during the year. At the time of the first examination, June 21, 98 per cent of the stages found were above ground, and only two per cent were below ground.

At this date there were no potatoes forming. However, on July 9, when small potatoes were beginning to form, 22 per cent of the stages found were below ground. The percentage of stages below ground averaged 16 per cent throughout the growing season after potatoes began forming until September 18, when the stages found below ground increased to 86 per cent. At the end of October this figure had increased to 94 per cent and in November the vines had been killed and all stages were below ground. The explanation for the sudden change from 16 per cent of stages below ground to 86 per cent below ground in September is that at this time the potatoes had developed to the extent that they were cracking the soil and were presenting an easy entrance for the adult weevils to infest them. The total per cent of plants infested gradually increased from 33 per cent on June 21 to 100 per cent by the first of November.

The complete information obtained from the field investigations is given in Table 5.

An experiment was conducted to determine the reaction of the sweet potato weevil adult when exposed to various qualities of light. In these tests the weevils were more active in the violet end of the spectrum, followed by the blue, red, orange, yellow, and green, respectively. In other similar tests it was found that the weevils were more active, that is they fed more and oviposited more, in the dark than they were in the light, or in any single color. Oviposition, in all cases, was in direct proportion to the amount of feeding done. That is, the light color or ray did not affect one of these factors without influencing the other.

An experiment was designed where tangle-foot and "Dead-line," a product similar to tangle-foot, were applied to the crowns of growing plants. Since the early infestation begins in the crown of the plants, it was thought that the presence of these sticky materials would prevent the female weevils from ovipositing by trapping or repelling them. Some of the test plants were treated with the materials full strength, while others were treated with the materials diluted with mineral oil. In a third test the tangle-foot and "Dead-line" were emulsified and the emulsion applied to the crowns. In other small tests calcium arsenate, copper arsenate, lime, and cryolite were added to the tangle-foot treatments.

Plants treated with tangle-foot or "Dead-line" did not develop any visible injury during the growing period; however, the yield of potatoes from these plants was decreased as compared to check plants. The addition of the insecticides, other than cryolite, to tangle-foot and "Dead-line" caused considerable plant injury.

Data obtained from this experiment showed that tangle-foot or "Dead-line" on the crowns of young plants in the field served as a fairly effective barrier against the female sweet potato weevil ovipositing in the crowns for the first few days, or until the vine tips began to drop and touch the soil. At this time it was noted that the weevils crawled up the plant from that location and oviposited in the stems.

TABLE 5—RESULTS OF A WEEKLY EXAMINATION OF 100 HILLS OF POTATOES FROM JUNE 21 THROUGH DEC. 25, 1940

	6-21-40	6-29-40	7-9-40	7-16-40	7-23-40	8-1-40	8-8-40	8-14-40	8-21-40	9-18-40	1-31-40	11-15-41	12-25-41
Number of eggs	54	97	37	17	7	19	5	3	25	358	272	396	385
Number of 1st Instar Larvae	1	18	46	100	140	114	40	24	44	491	678	585	179
Number of 2nd Instar Lavae	0	11	33	66	174	142	92	58	128	723	686	337	148
Number of 3rd Instar Lavae	0	0	22	49	125	152	178	156	183	1609	1717	662	559
Number of Pupae	0	0	0	9	18	36	40	72	43	1167	1337	598	431
Number of Adults	0	0	0	0	5	23	70	126	222	402	986	820	581
Number of Stages Found in Stem	18	55	81	109	271	413	405	430	625	586	350	....	....
Number of Stages Found in Base of Petiole	33.4	64.7	57	132	198	73	20	9	20	61	30	....	....
Percent of Stages Found Above Ground	97.9	98.7	78.0	72.3	89.0	89.4	84.7	84.0	87.1	13.6	7.16	....	....
Percent of Stages Found Below Ground	2.1	1.3	22.0	27.7	11.0	10.6	15.3	16.0	12.9	86.4	93.84	100	100
Average Distance of Stages Above Ground	4.57″	2.80″	3.15″	5.42″	8.05″	7.87″	7.17″	8.94″	8.45″	20.0″	25.0″	....	....
Average Distance of Stages Below Ground	2.00″	1.00″	1.69″	1.83″	1.47″	1.68″	2.06″	1.72″	1.60″	2.0″	2.0″	....	....
Total Number of Stages Found	55	126	138	241	469	486	425	439	645	4750	5675	3398	2285
Total Number of Infested Plants	33	46	56	74	73	81	85	86	91	98	99	100	100
Total Number of parasites	....	....	....	....	....	....	9	8	7	28	9	0	0

Notes on the Biology and Control of the Velvetbean Caterpillar, *Anticarsia gemmatilis* Hbn.

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Since the velvetbean caterpillar first attracted widespread attention as a pest of soybeans in Louisiana in 1928, it has been a yearly pest, attacking not only soybeans, but alfalfa, cowpeas and peanuts as well. In some years the damage has been more severe than in others, but the fact that it has caused damage yearly in some localities indicates that it is a pest of primary importance to the soybean grower. It is likely that this insect will come to be of even greater economic importance, since the acreage planted to soybeans is increasing. Especially will this be true if late maturing varieties are planted for seed production.

In this paper is given information on several phases of the bionomics and control of this species.

LIFE HISTORY

Egg—The almost hemispheric-shaped eggs are from one to one and one-half millimeters at their greatest diameter and are sculptured with a series of ridges converging at a very prominent micropyle. When first laid they are a pale greenish color but gradually become darker and just before hatching are a reddish brown in color. The eggs are laid late in the afternoon and at night singly and rather promiscuously over the plant, being found often on the veins and midribs on the undersides of the leaves, on the stems, seed pods, and less frequently on the upper side of the leaves. Very few of the eggs are placed flat on the leaves, stems or pods, but instead are attached to the hairs or spines protruding from these plant parts. Under conditions existing in Louisiana during July, August, and September, the eggs normally hatch in three days, but later in the season, when the temperature decreases, the incubation period is correspondingly increased.

Larva—The small larvae are usually green in color and have the looping habit, but they lose the looping habit when they become about one-third grown, and individuals may vary markedly in color, especially when feeding on different types of foliage. The general coloring of the body varies from dull green to olive brown, and some are almost black. A number of white lines run the entire length of the body; one dorsal and two lateral which are separated by a blackish shade, and a distinct yellow and white pair along the stigmata with a little dark edging below.

Larvae feeding on plants which have been mostly defoliated usually turn almost black in color before reaching maturity, whereas those feeding where the foliage is luxuriant usually remain green or turn to an olive brown color. There are eight pairs of legs; three thoracic, four abdominal, and one caudal. This fact makes it easily possible for the layman to distinguish velvetbean caterpillars from other species of caterpillars usually found feeding on soybeans at this time of the year. The green clover worm has three pairs of thoracic legs, and only three pairs of abdominal legs and one caudal pair, while loopers (Autographa sp.) have only two pairs of abdominal prolegs. The older larvae throw themselves from the plants when disturbed, while larvae of other species present on soybeans will sometimes fall off the plants when disturbed but do not throw themselves off. At Baton Rouge during July, August and September, the larval stage lasts for about three weeks, the mature larvae being about one and one-half inches in length. During development the larvae molt five times. The mature larvae drop to the ground and either burrow into the soil, usually just below the surface, or merely crawl underneath dried leaves or other trash and form a cell in which they change to the pupal stage.

Pupa—The pupae are dark brown in color and are about three-fourths of an inch in length. During the summer and early fall the pupal stage lasts about eight to 12 days, but later in the season when the temperature is lower, it may last for as long as 46 days.

Adults—The wing expanse of the adults varies from about one and one-fourth to one and three-fourths inches. The moths vary in color from a light brown or almost buff to a dark brown or almost black, the darker forms being present late in the season. Regardless of the color of the moths, they all have a line, which may be either lighter or darker than the general ground color that extends diagonally across the wings, running half way up the wings, forming a part of a circle when the moth is at rest.

The moths are inactive in the day, usually resting on the ground or close to the ground on leaves or other debris, and when disturbed make darting flights for short distances and again become inactive. Late in the afternoon they become active and can be seen darting in and out of the plants.

It is at this time that egg laying begins, and, no doubt, extends on through the night. The moths are not strongly attracted to lights early in the season, but just before cold weather sets-in light posts have been observed to be completely covered with them.

SEASONAL HISTORY

Hinds and Osterberger (1) state that in 1930, soybean caterpillar larvae were found in south Louisiana on June 13. This is the earliest record of the caterpillars in Louisiana. In Florida they have been taken in early April, but according to Watson (2) they rarely appear in destructive numbers until August or September. During the past four years the first infestation of damaging numbers occurred between August 1 and August 15, and the fields actually defoliated by this brood were limited. Studies indicate that this brood is the second generation, the first generation being scattered and not sufficiently abundant to actually defoliate beans. The third generation, occurring about the middle of September, is the one which has proved most destructive. Often the latter part of the third generation caterpillars are heavily attacked by a fungus and parasites and predators, so that the larvae occurring after this time (that is, in October and November) seldom do much damage. All stages of caterpillars can be found from soon after they first make their appearance until frost, but there are well defined peaks of abundance.

Watson (3) expressed the opinion that the limiting factor in the overwintering of *A. gemmatilis* in Florida was the lack of food in the winter, singe the leguminous plants on which they feed are killed out far down into the Peninsula. The lack of favorable food plants is not a factor in the failure of the species to overwinter in Louisiana, since alfalfa, on which they feed and on which they are usually abundant in the late fall, is rarely killed by cold weather in south Louisiana, but no stages of Anticarsia have been found on this plant after heavy frosts appear. It appears, then, that the limiting factor in the overwintering of Anticarsia in Louisiana is the cold, since the species cannot pass over the occasional periods of freezing temperatures.

VARIETAL RESISTANCE OF SOYBEANS

Soon after an investigation on the biology and control of the velvet bean caterpillar was started in the fall of 1936, it was observed that certain varieties of soybeans grown commercially in Louisiana were more resistant to the caterpillars than were other varieties. Some fields of soybeans were observed that had been completely denuded of foliage, whereas adjoining fields and others in the near vicinity were damaged slightly or not at all by the caterpillars.

In 1937 fields of soybeans were planted in such a manner so that additional information could be obtained on the subject. In the tests made the varieties of soybeans planted were the otootan, avoyelles, and palmetto. In general these three varieties represent the types of soybeans grown commercially in Louisiana.

The otootan variety is known as the "viney" type of soybean. On fairly fertile soil this soybean covers the ground with its foliage and continues to grow until seeding has commenced, which does not take place until late in the season. In contrast to this variety, the avoyelles soybean is a much more woody, heavily stemmed, upstanding variety of soybean. It does not send out tendrils except under unusual conditions. When this variety is planted early in the season, practically all of the leaves are very thick and tough at the time the caterpillars appear in the fall. The palmetto variety is one intermediate between these two. It is not as woody a type of soybean as is the avoyelles variety, nor does it send out as many tendrils as does the otootan variety. The leaves are not nearly so thick and tough in appearance as those of the avoyelles variety.

These three varieties of soybeans were planted in adjoining fields of five acres each during the second week of April. Since it had been observed in the previous year that the age of soybeans at the time caterpillar moths appear seems to have some effect on their attractiveness, a second planting of the same varieties and of the same acreage was made about the middle of June.

When the caterpillars appeared about September 1, the otootans of both plantings had entirely covered the ground. The avoyelles of the first planting were standing upright, and only a narrow clear space in the middle of the row could be seen. However, the second planting of this variety had fallen over and resembled the otootan variety somewhat in appearance, and they were still growing at this time. The early planted palmetto soybeans had also covered the ground, but those of the second planting date were comparatively small and rather skippy in stand. Velvet bean caterpillar larvae were first observed to be fairly abundant in both fields of otootan soybeans and the field of late planted avoyelles soybeans about September 1, and it was necessary to apply an insecticide to these soybeans to prevent damage by the caterpillars. The field of early planted avoyelles soybeans had very few larvae in it, and no damage resulted. Although the larvae were fairly abundant in the fields of palmetto soybeans, it was not necessary to apply an insecticide at this time. By September 15, the caterpillars had again become very abundant in both fields of otootans and both fields of palmettos and in the late planted field of avoyelles. An insecticide was necessary to prevent defoliation of these soybeans at this time. However, the field of early planted avoyelles contained very few larvae, and an insecticide was not applied. About a week later, however, larvae crawled from adjoining fields of soybeans which had been cut for hay, and defoliated the field of early planted avoyelles within a day or so.

From this test it appears that when these three varieties of soybeans are planted early in the season, the avoyelles variety is likely to escape injury from the caterpillars so long as an abundant supply of more favorable varieties is present. However, if the avoyelles variety is planted later in the season, so that its foliage has not become thick and tough when the caterpillars appear, it is very susceptible to attack by the caterpillars.

There has been an opportunity to make many observations in the state during the past four years, and the points brought out in this test appear to apply in most cases. Those soybeans which are growing and tender at the time the moths appear are the most favored by the ovipositing moths, providing their foliage is fairly luxuriant. The velvet bean caterpillar moth is rather secretive in its habits and prefers those places which afford a great deal of protection during the day, and for this reason does not favor fields of soybeans which do not fairly well cover the ground. A soybean like the Biloxi, a variety which stands very upright, often escapes injury, not because the foliage is undesirable, but because it does stand upright and there is not a great deal of protection for the moths during the day.

Certain varieties of soybeans, like the avoyelles for instance, have a very thick, tough appearing leaf late in the season, with few or no young tender leaves present. Soybeans of this type are not favored by the ovipositing moths and will often escape injury if other more desirable food is present.

The characteristic of the soybean which prevents it from being defoliated early in the season should be considered a desirable trait, since if it escapes early injury, it may not be defoliated later on. The velvet bean caterpillar is subject to many different parasites, predators, and to a fungus disease, which have a tendency to prevent damage later in the season.

HOST PLANTS

It appears that the velvetbean caterpillar will develop on most, if not all, leguminous plants. In Louisiana, soybeans appear to be the preferred host; however, the caterpillars attack readily alfalfa, and late in the season when the soybeans have become old and tough, alfalfa is preferred. Cow peas are often defoliated, but usually not unless there is a very heavy infestation of caterpillars and a shortage of soybean and alfalfa foliage results. Peanuts are also severly damaged in some years by the caterpillars, but as in the case of cowpeas, they are usually not harmed until there becomes a shortage of soybean and alfalfa foliage. Velvetbeans are attacked, but seldom damaged severely.

Plants of less economic importance on which the species has been observed feeding are: Kudzu vines, horse beans (*canovalia* sp.), sword beans, tender tips of black locust (*Robinia pseudacacia*), and coffee weed (*Sesban macrocarpa*).

CONTROL

NATURAL—A large number of predators and parasites attack this species, especially during the larval and egg stages. Among the predators, various species of birds play an important part in checking the caterpillars, and in localities where the acreage of soybeans is small and birds are abundant they, no doubt, give fairly satisfactory control. The following species are the birds most commonly observed feeding on the caterpillars: red-winged black bird, grackel, bobolink (rice bird), the green sparrow, English sparrow, kill deer, and mocking bird. Rodents such as skunks and moles also feed on the larvae and pupae.

Many species of insect predators are known to take the larvae, among which are: various species of vespoid wasps; pentatomids (*Podisus macyliventris; Proxys punctylatus;* and *Stiretrus anchorago*); the carabid beetle, *Calasoma sayi,* both the larvae and adults of which attack the larvae and pupae of the caterpillars; robber flies; fire ants; and lady bird beetles, which feed upon the eggs and small larvae.

Of the various parasites which attack Anticarsia, the most effective one in Louisiana appears to be the egg parasite, *Trichogramma minutum.* This egg parasite is usually active when Anticarsia eggs first become numerous on the soybean foliage, and increases in numbers until towards the end of the season, when nearly 100 per cent of the Anticarsia eggs may be parasitized. A number of primary parasites attack Anticarsia, but are seldom of economic importance in controlling the species. Among those reared are: the tachinid, *Winthemia rufopicta* Bigot; a sarcophagid, *Sarcophaga rapax* Walker. Hinds reports that two large ichneumons (*Ephialtes acqualis* (Prov.), and *Ophion bilineatum* Say) were bred from pupae.

A fungus disease caused by *Spicaria prasina* (Maulb.) Saw. is very effective in controlling the caterpillars under certain conditions. The disease usually does not become epidemic until the last of September or early October when prolonged periods of relatively cool humid weather occur. Severe infestations of caterpillars have been observed which were completely controlled by this fungus, the white, cottony-appearing bodies of the caterpillars being very prominent on the plant stems. While the natural enemies mentioned above play an important part in controlling the velvetbean caterpillar, seldom or never are their combined effects sufficient to prevent damage by at least one generation of the caterpillars when they occur in large numbers. As has been pointed out previously, the second and third generations of caterpillars which appear about August 15 and September 15, respectively, are usually the ones that do the most damage. In the years when observations have been made, the generation that occurs about August 15 is restricted, defoliating beans only in localized areas, but the next generation, which occurs about one month later, is likely to be widespread and cause much damage. After this time, however, the natural enemies are sufficiently active to stop damage.

Applied—From the above discussion of the biology of the velvetbean caterpillar and the combined efforts of its natural enemies in controlling the species, it is evident that in Louisiana the period over which beans must be protected is rather short. Since the species does not normally occur in destructive numbers until August or September, the beans grown for forage or soil improving purposes can be either harvested or plowed under before being seriously damaged by the caterpillars. The beans to be protected, therefore, are those which are grown for seed production.

During the past four years laboratory and field experiments have been conducted with organic insecticides such as fixed nicotine, rotenone containing insecticides, and pyrethrum insecticides, and with inorganic insecticides such as basic calcium arsenate, basic lead arsenate, magnesium arsenate, basic copper arsenate, cryolite and barium fluosilicate. None of the organic materials showed any promise, since none of them were very toxic to the caterpillars. Most of the inorganic insecticides were toxic to the caterpillars, and several were not injurious to the foliage of the soybean.

Very effective control of the caterpillars has been obtained without any injury to the soybeans with fluorine insecticides. Extensive field experiments have been conducted during three seasons with one of these, *Alorco* cryolite, and good control has been obtained with this material when applied at the rate of 6 to 8 pounds per acre or, when diluted with equal parts of talc or some other carrier, at the rate of 10 to 14 pounds per acre. Another brand of synthetic cryolite, *Syncryolite,* was tested in the fall of 1939, and the control obtained with it was equally as good as that obtained with *Alorco,* although it was less satisfactory from the standpoint of dusting quality. *Dutox,* barium fluosilicate, has also given fairly satisfactory results, although it has caused slight burning of foliage in some tests. It is also slightly slower in its action on the caterpillars and not as easily applied as *Alorco* cryolite. In the fall of 1937, tests on approximately 100 acres of soybeans with *Alorco* cryolite revealed that only one application of insecticides was necessary to give seasonal control. In 1938, in two test plots which were dusted about the middle of August, a second application of poison was needed in September, but in all the other tests only one application of poison, applied in September, was needed to give seasonal control. Only one application was needed in the fall of 1939 to give seasonal control.

All of the arsenicals, with the exception of magnesium arsenate, showed high toxicity to the caterpillars, but due to their phytocidal action, only basic copper arsenate appears to have promise. In extensive laboratory tests and limited field tests basic copper arsenate compared favorably with cryolite in both toxicity and in dusting qualities, and also in not being injurious to soybean foliage. Further work is contemplated with this material.

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Insecticidal Tests Against Cabbage Caterpillars

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Since the inauguration of the study of cabbage caterpillars by the Bureau in 1932, considerable time has been devoted to tests comparing the relative value of materials considered less toxic—in some instances non-toxic—to human beings than the arsenicals which are used as insecticides. Among these tests were three experiments in which non-volatile nicotine dusts and several materials as conditioning agents for rotenone dusts were used. One experiment was devoted to each—the non-volatile nicotine dusts, the materials as conditioning agents of rotenone dusts, and jointly to the two. These experiments were of a preliminary nature and not sufficiently replicated for definite conclusion and the results were largely negative. However, certain trends were apparent and are considered important enough to justify their being recorded. Therefore, these data are presented for whatever they may be worth.

METHODS

All three experiments were conducted on small field plots with the treatments replicated in latin square arrangements or randomized blocks. Each plot consisted of four rows 50 feet long and three and one-half feet or four feet wide. The Copenhagen Market variety of cabbage was used as the test crop. Methods of cultivation best adapted to the locality were employed. The insecticidal applications were made with rotary type hand dusters by going once to the row until the plants began to form heads, and with two trips per row, one on each side, thereafter.

The treatments were evaluated by caterpillar survivals and yield of cabbage produced. The observations on caterpillar survival—the time they were made in relation to the insecticidal applications and the number of plants examined—varied in the different experiments. For yields, the plants on the inner 44 feet of the two middle rows of each plot were harvested. Yield calculations are based on rows three feet wide, although those actually used ranged from three and one-half to four feet wide. This was done to make these data comparable with that being published in other papers—joint work of the Charleston, South Carolina, and Baton Rouge, Louisiana, laboratories. The plantings were examined at approximately weekly intervals and all plants having reached maturity were harvested and classified with the number of plants and their net weights (plants of those classes having heads of marketable size—one-half pound or over, net weight) of the different classes recorded according to a predetermined classification.

The classification was based on standards set up by the Bureau of Agricultural Economics. By this classification, cabbage was classed as marketable when it showed no injury or only a relatively small amount of injury to the firm head and/or to the four wrapper leaves. However, if the injury extended to more than the two outer leaves of the firm head, the cabbage did not meet these requirements, even though other injury was slight. Heads of marketable size containing injury exceeding that described above, and plants not making heads, or several small ones, known to have been caused by caterpillar feeding, including the destruction of the buds of the plants, were classed as unmarketable. A third class included plants which did not make heads of marketable size due to causes other than caterpillar damage. Since classes two and three (unmarketable cabbage) contained plants which did not make heads of marketable size, their yields are expressed in percentages.

A discussion of the setups, results, etc., by experiments follows:

EXPERIMENT ONE

The primary purpose of experiment one was to obtain information on the insecticidal value of a non-volatile nicotine dust (nicotine-peat) with cabbage caterpillars the test insects. Its effectiveness was compared with that of two dilutions of derris and one of calcium arsenate, and consisted of the testing of the four insecticidal dust mixtures by early morning applications in one latin square and by late afternoon applications in another. It was conducted on fall cabbage in 1936.

MATERIALS USED

The non-volatile nicotine dust used was a finely ground peat moss impregnated with nicotine. It was prepared by the Division of Insecticide Investigations and analyzed as follows: Total nicotine, 9.37 per cent (water soluble 2.96 per cent, and insoluble, 6.41 per cent); moisture, 5.24 per cent; and ash, 25.06 per cent. The stock derris root powder contained 2.9 per cent rotenone and 8.0 per cent total extractives. The calcium arsenate contained 45.39 per cent As_2O_3 (total) with 0.63 per cent soluble by the Geneva Method; and 4.0 to 5.0 per cent free lime (a special lot manufactured by the General Chemical Company).

INSECTICIDAL TREATMENTS: The insecticidal treatments consisted of five applications at two-week intervals of each of the four insecticidal dust mixtures. The applications were made on the following dates: October 9 and 10; October 22 and 24; November 6 and 7; November 20 and 21; and December 4 and 5.

EVALUATION OF TREATMENTS: The treatments were evaluated by caterpillar survivals and yield of cabbage produced with the data of the two experimental replicates combined. In the toxicological phase, the number of caterpillars by species on 100 plants per plot which survived the first application of the insecticides were recorded. The sample per plot consisted of four 25-plant sub-samples counted on the third, fourth, fifth and sixth days following the application. The yield data were obtained as indicated above.

The data by treatments on insecticidal applications, caterpillar survival by species (those species present in sufficient numbers for significant comparisons), those species combined which were present in sufficient numbers for comparisons individually, and all species combined; yield of cabbage produced by classes, are presented in table 6.

DISCUSSION OF RESULTS: As is shown in table 2, in the case of caterpillar reductions, calcium arsenate was relatively superior, in most instances significantly so, to the other three treatments; whereas there was but little difference between the two rotenone dusts, and, in all but one instance the nicotine-peat dust was significantly inferior to the other three insecticides. In the case of the yields, the ranking of the treatments differed considerably from that prevailing in the toxicological phase. The

TABLE 6—Average Amounts of the Insecticides Applied in the First and in All Five Applications, the Number of Caterpillars Surviving the First Application, and Cabbage Produced by Treatments in an Experiment Testing the Effectiveness of a Nicotine-Peat Dust vs. Derris and Calcium Arsenate Against Cabbage Caterpillars, Baton Rouge, Louisiana, 1936.

Insecticidal treatments	Rates of appl. per acre for		Average number caterpillars per 100 plants				Yield of cabbage		
								Plants unmarketable due to	
	First application, pounds	Total for all five appls., pounds	Cabbage loopers*	Cabbage webworm†	Miscellaneous species‡	Total all species	Marketable, tons per acre	Caterpillar damage, per cent	Other causes, per cent
Nicotine-peat-X-grade tobacco dust, 2-7.37	15	111	71.6	12.1	5.6	89.3	2.44	57	10
Derris-talc, 0.5 per cent rotenone	14	101	36.4	8.4	4.5	49.3	5.41	33	9
Derris-talc, 1.0 per cent rotenone	13	104	35.6	7.9	2.4	45.9	7.17	22	3
Calcium arsenate, undiluted	14	97	10.1	1.9	1.5	13.5	5.27	39	4
Differences required for minimum significance	....	....	15.2	4.5	1.5	23.1	0.64	....	....
Differences required for high significance	....	....	21.3	6.3	2.1	32.4	0.89	....	....

*Autographa brassicae, Riley

†Hellula undalis, Fab.

‡Composed of the imported cabbage worm (*Pieris rapae L.*), the diamondback moth (*Plutella maculipennis Curt.*), the tomato fruitworm (*Heliothis armigera F.*), the fall army worm (*Laphygma frugiperda S. & A.*), the garden webworm (*Loxostege similalis* Guen.), the southern cabbage worm (*Pieris Protodice* Bvd. & Lec.), and a Prodenia sp.

principal differences were in the raising of the relative effectiveness of 1.0 per cent rotenone treatment and the lowering of the calcium arsenate. As the data show, the nicotine-peat was highly significantly inferior to the other three treatments, the 1.0 per cent rotenone was highly significantly superior; and there was practically no difference between the calcium arsenate and 0.5 per cent rotenone. These data correspond closely with the amounts of visible caterpillar feeding on the respective treatments. Furthermore, there was very little difference in the amounts of visible caterpillar feeding on the nicotine-peat treatment and comparable untreated cabbage.

EXPERIMENT TWO

The purpose of experiment two was to obtain certain information on the relative value of several materials as conditioning agents for rotenone dust with cabbage caterpillars the test insects. The experiment consisted of testing of eight dust mixtures which were replicated four times in randomized blocks. It was conducted on fall cabbage in 1938.

MATERIALS TESTED: The materials tested as conditioning agents consisted of peanut oil, soybean flour, sodium oleyl sulfate, sodium salt of an alkylated naphthalenesulfonate, and sulfonated castor oil.

Dust mixtures of equal rotenone content were used in all of the treatments so that any differences which might occur could be attributed to the conditioning materials. A 0.5 per cent dilution of rotenone dust was used because in previous tests it had proven to be slightly too dilute to control satisfactorily the cabbage caterpillar populations which prevail on fall crops in Louisiana. This provided a margin for increased toxic effects that might be caused by any of the materials. The dusts were applied at intervals of approximately 10 days. It had been demonstrated in previous experiments that to control cabbage caterpillars effectively an insecticide should be applied at intervals not exceeding 10 days.

TREATMENTS: The treatments consisted of four applications of each of the eight dust preparations given in Table 2. The applications were made on October 4, 14, 25 and November 9.

EVALUATION OF TREATMENTS: The treatments were evaluated by caterpillar survivals and yield of cabbage produced. The caterpillars on 50 plants per plot surviving three and 10 days following the first application of the insecticides were recorded. The yield data were obtained as indicated above.

A study of the caterpillar survival data showed that in the first count the differences prevailing were non-significant, and in the second count, only the looper survival differences were significant. Therefore, the first count data are disregarded.

The rates of the insecticidal dusts applied, caterpillar survivals and yield of cabbage produced are presented in Table 7.

TABLE 7—THE INFLUENCE OF CONDITIONING AGENTS ON THE EFFECTIVENESS OF A DERRIS-TALC DUST CONTAINING 0.5 PER CENT ROTENONE IN CONTROLLING CABBAGE CATERPILLARS, BATON ROUGE, LOUISIANA, 1938.

Conditioning agent used in insecticide and percentage by weight	RATE OF APPL. PER ACRE FOR		CATERPILLARS SURVIVING PER 100 PLANTS 10 DAYS AFTER THE FIRST APPLICATION				YIELD OF CABBAGE		
	First application, pounds	Total for all four appls., pounds	Cabbage loopers	Imported cabbage worm	Diamond-back moth	Total all species	Marketable, tons per acre	Plants unmarketable due to	
								Caterpillar damage per cent	Other causes per cent
NONE	18	77	246	28	3	299	2.77	66	3
Peanut oil, 1.0 per cent	18	79	237	36	6	285	2.36	63	6
Peanut oil, 2.0 per cent	19	84	228	19	2	254	2.59	66	2
Sodium oleyl sulfate, 1.0 per cent	15	68	306	22	2	333	1.25*	80	4
Sodium salt of an alkylated napthalenesulfonate, 1.0 per cent	14	79	313*	23	2	344	2.23	69	3
Soybean flour, 4.0 per cent	13	72	303	31	3	350	2.13	68	4
Sodium salt of an alkylated napthalenesulfonate, 1.0 per cent, and soybean flour, 4.0 per cent	14	73	369*	23	3	413	2.53	63	3
Sulfonated castor oil, 1.0 per cent	16	70	327*	49	5	404	1.81*	69	5
Differences required for minimum significance	....	....	66	†	†	†	0.68	....	....
Differences required for high significance	....	....	90	....	....	....	0.91	....	....

*Significantly inferior to the unconditioned 0.5 per cent rotenone treatment.

†The difference required for significance was not calculated for the reason that the F test demonstrated that the treatment means are not significantly different.

DISCUSSION OF RESULTS: The unconditioned derris treatment was as effective as any of the conditioned ones in reducing the caterpillar infestation and was more effective than were those conditioned with 1.0 per cent of the sodium salt of an alkylated naphthalenesulfonate and 4.0 per cent soybean flour, and 1.0 per cent sulfonated castor oil. In producing marketable cabbage, the unconditioned derris was also as effective as the conditioned derris dusts and more so than those conditioned with 1.0 per cent sodium oleyl sulfate, and 1.0 per cent sulfonated castor oil.

The low yields were due to the small percentage of the plants making heads of marketable quality because of caterpillar damage, which averaged only a little over 28 per cent of the plants in the sampling areas. This demonstrated the ineffectiveness of 0.5 per cent rotenone dust in protecting cabbage against damage by these pests on fall cabbage in Louisiana.

As the data in Table 2 show, the cabbage looper constituted a large part of the caterpillar population involved in this experiment. Furthermore loopers are often infected by diseases which kill large numbers of them. During the period between the two counts, disease infections set in and had reduced the population to a relatively low level by November 15. This condition tended to devaluate the data concerned.

EXPERIMENT THREE

Experiment three consisted of six replicates of eight insecticidal treatments in a randomized block arrangement. Two primary objects were involved, namely; to obtain information on the value of (1) peanut oil and a sodium salt of an alkylated naphthalenesulfonate as conditioning agents for rotenone dusts, and (2) non-volatile nicotine dusts as insecticides for cabbage caterpillars. The experiment was conducted on spring cabbage in 1939.

TREATMENTS: The treatments consisted of five applications at intervals of 14 days of the dust mixtures given in column one of Table 3. The derris root powder used in preparing the dust mixtures contained 3.4 per cent rotenone and 11.2 per cent total extractives. The nicotine dusts used were prepared by a manufacturer of nicotine products. The applications were made on the following dates: March 31, April 14 and 18[6], May 2 and 16.

RESULTS: The caterpillar populations as determined by examining 25 plants in each plot and the yields of cabbage are given in Table 8. The plots dusted with derris-talc containing 1 per cent of rotenone contained fewer living imported cabbageworms at the time the examinations were

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[6] This was a more or less repeat application made because a rain occurred a few hours following the previous application.

TABLE 8—THE INFLUENCE OF PEANUT OIL AND A SODIUM SALT OF AN ALKYLATED NAPHTHALENESULFONATE AS CONDITIONING AGENTS ON 0.5 AND 1.0 PER CENT ROTENONE DERRIS-TALC DUSTS AND TWO NON-VOLATILE NICOTINE DUSTS IN CONTROLLING CABBAGE CATERPILLARS, BATON ROUGE, LOUISIANA, SPRING OF 1939.

Insecticidal treatments	AMOUNTS OF INSECTICIDES APPLIED FOR		CATERPILLARS SURVIVING PER 100 PLANTS 13 DAYS AFTER THE THIRD APPLICATION				YIELD OF CABBAGE		
								Plants unmarketable due to	
	Total of first 3 applications, pounds	Total of all 5 applications, pounds	Cabbage loopers	Imported cabbage worms	Diamond-back moth larvae	Total all species	Marketable, tons per acre	Caterpillar damage per cent	Other causes, per cent
Derris-talc, 0.5 per cent rotenone	42	76	114	52	33	185	1.47	44	14
Derris-talc, 1.0 per cent rotenone	43	82	105	18	16	142	2.39	22	10
Derris-talc, 0.5 per cent rotenone, peanut oil 1.0 per cent	45	80	88	25	43	157	2.05	32	10
Derris-talc, 1.0 per cent rotenone, peanut oil 1.0 per cent	46	84	97	21	32	149	2.51	22	7
Derris-talc, 0.5 per cent rotenone, sodium salt of an alkylated naphtahlenesulfonate, 1.0 per cent	53	90	147	23	60	229	2.05	36	6
Derris-talc, 1.0 per cent rotenone, sodium salt of an alkylated naphthalenesulfonate, 1.0 per cent	45	83	84	23	28	135	2.52	22	7
Nicotine bentonite containing 4.75 per cent nicotine	45	84	171	40	47	258	1.09	60	9
Dual-fixed nicotine, containing 3.75 per cent nicotine	43	90	127	37	44	207	1.10	60	9
Differences required for mininum significance	....	....	57	17	25	75	.50	....	....
Differences required for high significance	....	....	74	23	34	100	.68	....	....

made and yielded more marketable cabbage than did plots dusted with derris-talc dust containing only 0.5 per cent of rotenone or plots dusted with the two nicotine materials. There was some tendency for fewer surviving imported cabbageworms and higher yields where peanut oil and a sodium salt of alkylated naphthalenesulfonate was added to derris dusts. The latter was more pronounced when the conditioning agents were added to the dust containing 0.5 per cent of rotenone than when added to that containing 1 per cent of rotenone.

The insecticides appeared to affect the cabbage looper in about the same manner as they did the imported cabbageworm, but to a lesser degree.

The larvae of the diamondback moth seemed to be more susceptible to the nicotine materials than were the other species of caterpillars. The conditioning agents were not effective in increasing the toxicity of derris dust to the larva of the diamondback moth.

As in experiment two the derris dusts did not adequately protect the cabbage from caterpillar damage, a minimum of 22 per cent of the plants being unmarketable due to caterpillar damage.

SUMMARY

Studies on cabbage caterpillars conducted by the Bureau of Entomology and Plant Quarantine at Baton Rouge, Louisiana, included three experiments testing the effectiveness of three non-volatile nicotine preparations and several materials as conditioning agents for derris dusts. The nicotine preparations tested consisted of a finely ground peat moss impregnated with nicotine, nicotine bentonite, and a dual-fixed nicotine. The materials tested as conditioning agents for derris dusts consisted of peanut oil, sodium oleyl sulfate, sodium salt of an ankylated naphthalenesulfonate, soybean flour and sulfonated castor oil.

The nicotine preparations had little or no value as insecticides against cabbage caterpillars. A greater yield of marketable cabbage was obtained following applications of the derris-talc dust containing 1 percent of rotenone than following applications of the nicotine preparations, derris-talc dust containing 0.5 percent rotenone and undiluted calcium arsenate. The derris-talc dusts were effective but did not adequately protect the cabbage from caterpillar damage.

The tests on the addition of conditioning agents to derris-talc dusts gave variable results. During the fall of 1938 the conditioning agents were not beneficial and there was a tendency for the sodium salt of an alkylated naphthalenesulfonate to decrease the toxicity. During the spring of 1939, however, there was a tendency for both peanut oil and the sodium salt of alkylated naphthalenesulfonate to increase the effectiveness of derris dusts particularly that containing 0.5 percent of rotenone.

Losses Caused by Sugarcane Borer to Sugarcane in Louisiana in 1940*

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Another comprehensive study to determine the extent of injury to sugarcane in Louisiana by the sugarcane borer (*Diatraea saccharalis* (F.)) was conducted in the fall of 1940. This survey has been made annually since 1935, and the borer infestation data so obtained have been regularly of value in determining the various factors responsible for general fluctuations in borer population and the limits of practical expenditures for control. The survey for 1940 is of particular interest, however, since it reveals the pronounced effect of the extremely severe winter of 1939-40 on borer infestation and damage during the following crop season. As the season progressed it became apparent that some of the important crop pests were affected only a little, if at all, whereas others suffered materially. The numbers of overwintering larvae of the sugarcane borer, the most important insect pest of sugarcane in Louisiana, were generally reduced. Furthermore, the increase in borer population during the growing season of 1940 was abnormally slow, owing, apparently, to continued unfavorable weather.

Examinations were made on the same 10 plantations covered in previous surveys, each plantation being in, and representative of, an area producing approximately one-tenth of the total sugarcane grown for sugar in Louisiana. On each plantation six fields were selected for sampling that would be proportionately representative, as to acreage, of the locally prevalent varieties of sugarcane and soil. The sample from each field consisted of 10 consecutive stalks from each of 10 locations in the field. Five of these ten-stalk lots were taken alternately from two adjacent rows one-third of the distance across the field and the other five were taken alternately from two adjacent rows two-thirds of the distance across the field. The samples were taken approximately equidistant from each other in the rows and from the ends of the rows. The extent of borer injury was ascertained by determining the percentage of joints that showed external evidence of infestation. Studies have shown this to be a fairly accurate method of estimating the percentage of joints bored.

An effort was made to select stubble cane for examination, but when such cane was not available, plant cane was used instead. Former studies have shown that there was no significant difference between final infestations in comparable fields of stubble and of plant cane, hence the age of the cane was not considered in interpreting results.

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* Cooperative work. The position of the authors' names does not indicate seniority.

A summary of the results for 1940 together with those for the entire period during which these surveys have been conducted is given in Table 9. It may be noted that the estimated average percentage of joints bored in 1940 was 5.27 as compared with 19.74 percent in 1939. The infestation on eight of the 10 plantations in 1940 was the lowest for any year of the six during which this type of survey has been conducted. The only plantation on which the infestation approached normal was in District 1, where it had been higher than in any other district each year for the three preceding years.

TABLE 9—Sugarcane Borer Infestation, as Measured by Percentage of Joints Bored, on Representative Plantations, From 1935 to 1940, Inclusive.

District	1935	1936	1937	1938	1939	1940
1.	9.9	8.00	26.35	37.03	31.68	17.68
2.	9.8	7.40	13.12	15.21	22.46	4.63
3.	9.4	9.94	16.12	15.16	21.05	5.22
4.	2.7	9.38	8.62	9.09	9.24	.81
5.	6.1	7.89	7.77	8.75	8.42	4.03
6.	10.4	4.97	15.03	14.74	18.89	8.84
7.	3.1	1.87	5.67	5.18	10.30	1.63
8.	4.4	3.58	14.53	14.65	23.00	1.31
9.	13.3	8.53	19.81	17.13	27.38	2.44
10.	11.5	25.43	33.50	21.57	25.02	6.15
AVERAGE	8.1	8.70	16.05	15.85	19.74	5.27

The value of the 1940 sugarcane crop milled for sugar in Louisiana was approximately 11 million dollars. With an average of 5.27 percent of the joints bored, it is estimated, on the basis of studies previously conducted to determine sucrose and weight losses in bored cane, that the borer loss in 1940 amounted to about $750,000.

The first apparent effect of the extreme cold on the borer was the high mortality of the larvae in hibernation. Examination after the freezes to determine the status of overwintering borers in cane, cane trash, and corn indicated that the survival was only about 15 per cent of normal. Since the early spring infestation results from the emergence of overwintered borers, the amount of early damage is, of course, largely dependent on the numbers of larvae successfully surviving the winter.

Extensive search for first-generation borer eggs in April and May yielded very few egg masses. In fact, the first-generation borers were so very scarce that insecticidal control experiments had to be postponed until second-generation borers appeared. Then, contrary to what usually occurs, the increase in second-generation borers was very slight.

A comparison of first-generation infestation, in what was considered the most heavily infested fields in 1939 and 1940, revealed that the infestation in 1940 was only about one-twentieth of that prevalent in 1939. Second-generation infestation was only about one-ninth of that prevalent in 1939.

It seems apparent from the data obtained that the sugarcane borer population was greatly reduced by the severe winter of 1939-40 and failed to recover during the growing season of 1940. As a result, borer injury for that year for the whole State was the lightest yet observed during the current century.

A Summary of Recent Investigations of Sugarcane Borer Control with Cryolite and Other Insecticides*

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A number of insecticides have been tried in various countries for the control of the sugarcane borer, but prior to the testing of cryolite none of them had given a sufficiently high degree of control to warrant their use on a commercial scale. Following the development of cryolite as a good insecticide for the control of other insect species, however, laboratory experiments conducted by the Louisiana Agricultural Experiment Station in 1936 indicated that this chemical would be worth testing against the borer in field plots. In the fall of 1937, therefore, this Station, in cooperation with the Bureau of Entomology and Plant Quarantine, of the United States Department of Agriculture, began further investigations of borer control by means of insecticides, with special emphasis on the use of cryolite. These studies are still in progress and the present article is a preliminary report on this work.

Domestic synthetic cryolite is a byproduct of the aluminum industry and contains 85 to 90 per cent of sodium fluoaluminate. At present bulk quantities of this material would cost from 11 to 13 cents per pound delivered in Louisiana. The total cost of making four applications to control first-generation borers is estimated at between $3 and $4 per acre. Under normal plantation conditions it would probably be worth while to dust only the stubble cane, and of that only such fields as are located in areas usually suffering average or above-average infestation. Thus, dusting only about 30 or 40 percent of the cane on a given plantation might give a high degree of borer control for the entire plantation. Dusting might be of special value in controlling borers in seed plots and in valuable seedling canes. Seedling canes being tested by the Bureau of Plant Industry at Houma have been dusted at times in the past to eliminate the variable of borer injury. No appreciable burning of sugarcane plants has resulted from the use of cryolite.

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* Joint cooperative work. The position of the authors' names does not indicate seniority.

Two small replicated-plot experiments to test various insecticidal treatments are being conducted this year (1941) on first-generation borers, one on Southdown Plantation and one on Sterling Plantation. Large-acreage experiments in controlling first-generation borers are being conducted on Albania, Oaklawn, and Reserve Plantations. It is planned to conduct additional experiments on second-generation borers.

General Procedure.—Past experience and knowledge of borer life history indicated that control possibilities were greatest with young borers before they entered the cane stalk and with small cane that could be more easily covered by an insecticide than larger cane. Hence it was decided to concentrate on the control of borers of the first and second spring generations.

The experiments were of two types. In replicated small plots Bordeaux-calcium arsenate, derris, nicotine sulfate, dual-fixed nicotine,[1] pyrethrum, 2-4-dinitro-6-cyclohexylphenol mixed with sulfur, and various forms of cryolite, all applied as dusts, were tested to determine their value in killing borers. In large-acreage plots an effort was made to determine the harvest-time value of applying synthetic cryolite weekly during the spring to control the first generation of the borer. The small-plot experiments were each made up of four to six small plots of each treatment, each plot being five rows wide and 72 feet long, or one-twentieth of an acre in size. There was a buffer area of 20 to 30 feet at each end and a buffer area of not less than three rows on each side between individual plots, and these buffer areas were untreated. Insecticides were applied at the rate of 10 to 12 pounds per acre in the small plots.

Small-plot experiments in the fall on cane planted the preceding summer.—Since the fall growth of summer-planted cane closely resembles that of cane in the spring at the time of first-generation borer injury, preliminary small-plot experiments were conducted in the fall on such cane. The plants were dusted at weekly intervals with the various insecticides to be tested, at the rate of about 10 pounds of dust per acre beginning with the finding of the first borer eggs and continuing until eggs were no longer found on this cane. In 1937 one experiment was conducted on Reserve Plantation and another on Raceland Plantation. Examinations to determine the degree of borer control consisted of determining the number of borer-killed plants and borer stages in representative samples from each plot. In terms of live borer stages found, the following percentages of reduction in numbers of borers as compared with infestations in untreated areas were obtained: With synthetic cryolite at Reserve Plantation 89 percent and at Raceland Plantation 92 percent, with natural cryolite 92 and 96 percent, and with Bordeaux-calcium arsenate an increase in borers of 28 and 39 percent. Natural cryolite was so difficult to apply that it was not included in future experiments until 1941.

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[1] A product made up of nicotine-tannate powder and nicotine-bentonite powder and containing 3.75 percent of nicotine. It was developed by C. H. Batchelder.

In a similar experiment in the fall of 1938, with both domestic and imported synthetic cryolite, dusting was started late and consequently some borers escaped treatment. However, on borers from eggs that hatched after dusting was begun domestic synthetic cryolite gave a 97 percent reduction in borer stages and imported synthetic cryolite gave practically the same degree of control. Lengthening the interval between applications from seven to 10 days and to two weeks decreased the effectiveness of synthetic cryolite.

In an experiment in the fall of 1939 synthetic cryolite gave 91 percent reduction in number of borers, synthetic cryolite mixed with an equal weight of sulfur 51 percent reduction, and sulfur alone resulted in a 30 percent increase in borers over the untreated check plots. A mixture of 94 percent of sulfur with 1 percent of 2-4-dinitro-6-cyclohexyphenol and 5 percent of inert material gave no decrease in borer population.

In the fall of 1940 no summer-planted cane was available for experiments owing to unfavorable weather at planting time.

Small-plot experiments in first-generation borer control.—In small-plot tests for the control of first-generation borers the plants were dusted four times at weekly intervals beginning with the earliest hatching of the insects. Three small-plot experiments were conducted in 1938, but in only two of these was the borer infestation sufficiently high to give reliable data. In these two experiments synthetic cryolite gave 96 percent control, synthetic cryolite diluted with an equal weight of talc 78 and 81 percent, dusting cryolite,[2] which contained only 31.7 percent of sodium fluoaluminate, 72 and 78 percent control, and dual-fixed nicotine only 11 and 9 percent control. Dusting was continued through the period during which the second generation was becoming established. In three additional experiments in 1938 the dusts were applied only twice and three times. Owing to the small number of applications and to the fact that dusting was begun after the peak of hatching of first-generation borers, less than 50-percent control was obtained with synthetic cryolite.

In 1939 three experiments were conducted in which domestic synthetic cryolite dusts, with and without phenothiazine or a spreading agent, were tested with four applications at weekly intervals and three applications at 10-day intervals. In only one experiment a sufficiently high infestation developed to give reliable results. In this test synthetic cryolite dust alone when applied four times at weekly intervals gave 92-percent control of borer larvae and when applied three times at 10-day intervals gave 65-percent control. When mixed with 1 percent of a proprietary compound containing phenothiazine and applied three times at 10-day intervals this insecticide gave 75-percent control and when mixed with 1 percent of proprietary spreader gave 47-percent control. Synthetic cryolite applied three times at weekly intervals beginning one week after first-generation borers began to hatch gave 76-percent control.

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[2] Another product of the same manufacturer from whom the domestic synthetic cryolite was obtained.

In 1940 the infestation was too light to justify conducting experiments on first-generation borers.

Large-acreage experiments on first-generation borers.—In 1939, on Reserve Plantation, 40 acres of cane were dusted with synthetic cryolite four times at weekly intervals for the control of first-generation borers. An average of 5.91 pounds of the material was used per acre per application and the dust was applied by means of a 5-row power dusting machine. In counts and examinations of dead hearts in May and June 73 first-generation borers were found per acre in the dusted area and 992 in the untreated check area. In August the percentages of stalks bored were 31.9 in the dusted area and 83.1 in the check area. At harvesttime the percentages of joints bored were 17.7 in the dusted area and 37.6 in the check area.

On Waterford Plantation 52 acres of sugarcane were dusted three times by airplane at intervals of eight to 10 days, the dust being applied at the rate of 9.6 pounds per acre per application. First-generation borers found per acre following the dusting were 111 in the dusted area and 218 in the check area. In August the percentages of stalks bored were 46.2 in the dusted area and 54.9 in the check area. At harvesttime the percentages of joints bored were 31.4 in the dusted area and 43.8 in the check area.

At Reserve the net profit from increase in yield of sucrose, in excess of that required to defray the cost of dusting with the ground machine, was estimated to be over $11 per acre. It was estimated that the value of airplane dusting at Waterford was about equal to the cost. The lack of profit in this experiment is thought to have been due to several factors, namely, the lighter infestation, the reduction in number of applications, the increase in time intervals between them, and possibly also to inefficiency of airplane dusting on small plants on rows 6 feet apart.

Experiments in controlling second-generation borers.—In 1938 three small-plot experiments were conducted in which dusts were applied weekly from early April until late June for the control of both first- and second-generation borers. On examination it was found that 1.7 percent of the joints were bored in the plots treated with synthetic cryolite as compared with 17.8 percent in the untreated plots. The percentages of joints bored in other treated plots were as follows: Equal parts of synthetic cryolite and talc 6.9, dusting cryolite 5.4, and dual-fixed nicotine 13.4.

In another set of three experiments in 1938 dusts were applied four times at weekly intervals while second-generation borers were hatching. In plots treated with domestic synthetic cryolite an average of 8.7 percent of the joints were bored, in those treated with synthetic cryolite and talc 10.0 percent, in those treated with dusting cryolite 10.2 percent, and in the check plots 19.7 percent.

In three other experiments in 1938 domestic synthetic cryolite was applied on ½- to ¾-acre plots for the control of second-generation borers, and alternate similar plots were left untreated. The insecticide was applied four times at weekly intervals from June 7 to 28 at the rate of six to eight pounds per acre. In the dusted plots an average of 5.1 percent of the joints were bored as compared with 12.3 percent in the untreated plots when examinations were made in midsummer. By harvesttime, however, there was little difference in the infestation owing to the movement of moths from untreated to treated plots.

In 1940 the borer infestation was extremely low, owing primarily to the unusually cold winter, and it was necessary to conduct all experiments on second-generation borers. Duplicate small-plot experiments were conducted, but the infestation was too low to give significant results. However, in one experiment there were twice as many bored stalks in plots dusted with copper arsenate as in the undusted plots and in the other experiment there were three times as many bored stalks in the plots dusted with this material as there were in the undusted plots.

Two large-acreage dusting experiments were also conducted in 1940 in which domestic synthetic cryolite was applied four times at weekly intervals with a ground machine to control second-generation borers. On Germania Plantation 23.7 acres of Co. 290 stubble and plant cane were dusted and on Sterling Plantation 22.9 acres of stubble cane of several varieties were dusted. At Germania in August the percentages of bored plants in stubble cane were 2.05 in the dusted area and 4.23 in the undusted area, while in the plant cane the percentages were 4.51 in the dusted area and 7.22 in the undusted area. At Sterling in August the percentages of bored plants were 4.30 in the dusted area and 11.04 in the undusted area. At Germania the harvesttime percentages of joints bored in the stubble cane were 6.83 in the dusted area and 7.64 in the undusted area and in plant cane 8.47 and 12.66, respectively. At Sterling the harvesttime percentages of joints bored were 5.51 in the dusted area and 12.19 in the undusted area. In each experiment rain fell on 14 of the 28 days in the dusting period, which undoubtedly greatly decreased the effectiveness of the insecticide.

Summary of findings and possibilities of borer control by dusting.—From experiments conducted to date it appears that either domestic or foreign synthetic cryolite can be depended on to kill 90 percent or more of the first generation of borers in the spring, provided the cane is dusted four times at weekly intervals beginning with the hatching of eggs laid by moths emerging from overwintered borers. This finding is further substantiated by a similar degree of borer control obtained with cryolite applied to small plants developing in the fall from cane planted the previous summer. When tried in small plots, the benefit of first-generation dusting was overcome by infestation resulting from the influx of later generations of moths from untreated areas. It was thought that the use of larger plots would to a great extent do away with this influx so that the dusting would show a benefit. This surmise was substantiated by the results of a large-acreage experiment conducted with a ground dusting machine in 1939. Further experiments are necessary to determine the harvesttime value of first-generation dusting. Dusting for the control of second-generation borers appears to be of rather doubtful value.

A New Practice for Red Spider Control on Strawberries

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During the last few years a new idea in the control of the red spider on strawberries in Louisiana has been developed and tested by Mr. J. K. Primm, entomologist with the Grasselli Chemicals Department of the E. I. du Pont de Nemours & Co., Inc. Mr. Primm's work was done in association with the Louisiana Agricultural Experiment Station at Baton Rouge, Louisiana and the Sub Station, located at Hammond, Louisiana. The following is a report on the work and observations made by Mr. Primm to the Agricultural Experiment Station when he had completed his work:

"Experiments in the use of Loro, an aliphatic thiocyanate preparation, to control red spider on strawberries were begun in January 1939 near Ponchatoula and were virtually completed in 1940. During this period Loro was applied as a spray to infested field plants and as a dip for seed plants just previous to setting them out. The superior efficacy of the dipping method over the spraying method was demonstrated in these experiments. Spraying with a Loro solution was ineffective because of the impossibility, even with a high pressure power outfit, to thoroughly cover the undersides of the leaves.

"The underlying conception of the dipping method lies in the fact that the spread of red spider is almost entirely confined, in Louisiana fields, to the setting out of infested seed plants, and that the likelihood of red spiders occurring in the pine needle mulch is practically nil.

"It was learned that red spiders develop from egg to adult during the winter months on a number of common weeds, chief of which are the wild geranium (Geranium texanam) and the primrose (Oenothera?). Infestation of clean plants from such sources is a possibility which justifies the precaution that after plants have been dipped infested host plants immediately adjacent to the strawberry field should be destroyed. Where dipped plants had opportunity of becoming infested from undipped plants it was found that the spread from row to row where clean culture is practiced, was very slow and apparently unimportant, at least up until the time of picking the crop.

"Successful control by dipping depends on the use of a treatment which will give nearly a complete kill of eggs, nymphs, and adults, Wettable sulphur and rotenone dips gave high kills of nymphs and adults, but reinfestation occurred soon after dipping in strong concentrations of these materials because of the poor egg kill obtained. Nicotine sulphate at a strength of one ounce per gallon also failed to completely kill nymphs and adults. Loro is outstanding in its ability to kill all stages of red spider from eggs to adults when it is used at proper strength.

"The procedure of dipping is comparatively simple and inexpensive. Twenty gallons of solution is enough to dip 12,000 to 15,000 plants, depending upon their size and how much of the drain is recovered. To make this amount one pint of Loro is poured into twenty gallons of water. A wash tub or small wooden vat makes the most convenient container for mixing and dipping. After the Loro and water have been thoroughly stirred together, two fluid ounces of Grasselli Spreader-Sticker, first diluted with a small amount of water, should be added. The addition of the wetting agent and the agitation of the plants while immersed, in such a way as to prevent the formation of air pockets or too tight a pack, will insure the coverage required.

"One method of dipping the plants is to pile them loosely in the carrier and immerse the entire carrierful. A second method is to take small bunches in the hand and plunge them in the solution before they are piled in the carrier. Both methods appear effective.

"The utilization of Loro in dipping strawberry seed plants before setting them out has changed the outlook of red spider control on strawberries where they are grown as annuals. Plants which are practically free from red spider when set out will go virtually through the whole picking season without requiring further treatment for this pest. They reach their cropping season without having their vitality appreciably impaired by red spider or root aphis attack."

Toxicity of Poison Baits to the Sweet Potato Weevil, *Cylas formicarius* Fab.

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Since the early infestation of sweet potatoes by the sweet potato weevil often originates from infested potatoes left in the field, old storage banks, and similar places, the idea was conceived to use a bait prepared from grated sweet potato mixed with some poison, which would kill these weevils, thereby greatly reducing the number of weevils left to start the initial spring infestation in the fields. It was also thought that the bait could be used after harvest time in the old fields and in headlands to kill out the weevils left there.

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Several poison bait formulae were prepared, using a number of toxic agents, and tried in experiments to determine if the weevils would feed on these baits and their effect on the insect.

Among the poisons tested were rotenone, calcium arsenate, Paris green, cal-green, London purple, copper arsenate, sodium fluoride, and barium fluosilicate. The tests were conducted in several ways in order to obtain as much information as possible. In some tests the baits were tried while they were fresh, in others after the baits had hardened and dried from exposure. In some experiments weevils on test had free choice of fresh potato or poison bait to feed on, while in others the poison bait served as the only food available.

The main disadvantage of the bait was that soft rot or mould quickly developed in freshly prepared stock when the temperature and humidity conditions were favorable for the development of the fungus. This factor, however, was overcome by the addition of a preservative to the baits.

The summary results of these poison bait tests are given in the following tables and discussions.

A test was run comparing the difference in toxicity between rotenone and Paris green in poison bait against the sweet potato weevil. The tests were conducted at a controlled temperature of 80° F. Results of this experiment are given in Table 10.

TABLE 10—SHOWING TOXICITY OF ROTENONE AND PARIS GREEN TO THE SWEET POTATO WEEVIL IN POISON TESTS (Temp. 80° F.)

Bait formula	No. weevils in test	No. of days test in progress	Total No. weevils dead	Percent of weevils killed	Date tests set up
20 gms. grated sweet potato; 1 gm. timbo root (4% rotenone)	150	9	51	34	1 /6/39
20 gms. grated potato; 1 gm. cube (5% rotenone)	200	9	173	86.5	1 /6/39
20 gms. grated potato; 1 gm. Paris green	186	3	186	100	1 /6/39
20 gms. grated potato; 1 gm. Paris green*	440	9	435	98.8	1 /9/39
20 gms. grated potato; 1 gm. Paris green (Rep. No. 2)*	140	7	136	97.1	1/18/39
CHECK	100	6	6	6	1/18/39

*Representing tests where fresh potato was given along with the poison bait, thus giving the weevils free choice of poison bait or fresh potato.

An examination of Table 10 shows that rotenone is much inferior to Paris green in the poison bait. It is interesting to note the effect of fresh potato along with the bait in these tests. When the Paris green—grated potato bait was used alone, a 100 percent mortality was secured in three days' time. In those tests where unpoisoned potato was added, the speed of kill was greatly slowed up. Even after nine days' exposure, the weevils were not all dead.

The second experiment was designed to test the effectiveness of the bait after it had become hard and dry. The baits were prepared and toxicity tests begun immediately in the laboratory. As soon as the time for the first batch of weevils was complete another batch was placed on, and the test continued for 56 days. Table 11 gives the results of this experiment.

A poison bait composed of 20 parts of grated potato to one part of Paris green is extremely concentrated and perhaps too expensive to be used in field control work. A test was designed whereby the concentration of Paris green in the baits ranged from one part to 20 to one part to 100 parts of potato. The purpose of this test was to determine the minimum concentration of Paris green necessary to kill the weevils effectively. Tables 12 and 13 show the results obtained from these feeding tests.

TABLE 11—SHOWING EFFECT OF AGE OF BAIT ON TOXICITY AND ATTRACTIVENESS TO THE SWEET POTATO WEEVIL (Temp. 80° F.)

Bait—25 gms. grated sweet potato plus 1 gm. Paris green

Test Number	No. of replications	Total No. of insects used	Date test begun	Age of bait	Percent mortality after 72 hours
1	4	40	12-9-40	1 day	92
2	4	40	12-14 40	5 days	100
3	4	40	12-17-40	8 days	100
4	4	40	12-19-40	10 days	100
5	4	40	12 21-41	12 days	100
6	4	40	1-2-41	24 days	100
7	4	40	1-6-41	28 days	100
8	4	40	1-10-41	32 days	100
9	4	40	1-13-41	35 days	100
10	4	40	1-15-41	37 days	100
11	2	20	2-3-41	56 days	100

*The bait in these tests was the only food available to the weevils. Tests were run in screen cages.

A study of Tables 12 and 13 shows that the concentration of Paris green can apparently be reduced from one part to 20 parts of potato to one part to 100 parts of potato without materially reducing the effectiveness of the bait in laboratory tests. However, the reduction in kill in the weaker baits is noticeable and particularly so during the first 24 hours.

In more recent tests in which the bait formulae, one to 20 and one to 100 were compared, it was found that in the stronger bait formula, one to 20, an average of 3.1 days were required to produce a 90 percent mortality; whereas in the weaker formula, one to 100, 4.7 days were required to produce the same results. The substitution of molasses for 5 percent of the grated potato materially decreased the effectiveness of the weaker bait formula in producing a 90 percent mortality.

Tests were conducted using insecticides other than Paris green in an effort to determine if some other toxic agent would be as effective in the bait as Paris green and make the bait cheaper. The other insecticides used were cal-green, London purple, copper arsenate, sodium fluoride, and barium fluosilicate. Results of these treatments are given in Table 14.

TABLE 12—SHOWING RELATIVE EFFICIENCY OF POISON BAITS CONTAINING VARYING PERCENTAGES OF INSECTICIDES* (Temp. 80° F.)

Bait formula	No. insects per test	Time examined	No. insects killed test No.						Average number killed	Average percent killed
			1	2	3	4	5	6		
Paris green, grated sweetpotato, 1-20	20	24 hrs.	12	14	16	19	12	3	13.16	65.80
		48 hrs.	17	19	18	19	14	18	18.00	89.99
		72 hrs.	20	19	19	20	16	18	19.16	95.68
Paris green, grated sweetpotato, 1-50	20	24 hrs.	9	8	13	12	13	12	11.16	50.80
		48 hrs.	17	18	17	15	16	19	17.00	84.87
		72 hrs.	19	19	18	20	18	20	19.00	94.91
Paris green, grated sweetpotato, 1-60	20	24 hrs.	7	9	9	9	12	5	8.50	42.50
		48 hrs.	16	18	18	16	16	19	17.16	85.63
		72 hrs.	18	19	18	20	18	19	18.66	93.18
Paris green, grated sweetpotato, 1-80	20	24 hrs.	7	5	13	12	7	6	8.33	41.65
		48 hrs.	18	17	17	17	10	19	16.33	81.50
		72 hrs.	18	19	19	20	12	19	17.86	89.12
Check (no poison)	20	24 hrs.	0	0	0	0	0	0	0.00	0.00
		48 hrs.	0	0	0	0	0	1	0.16	0.80
		72 hrs.	0	0	1	0	0	1	0.33	1.65

*The only food available in these tests was the poison baits.

All five of the insecticides compared with Paris green as the killing agent in the sweet potato weevil poison bait proved more or less toxic to the weevil; however, cal-green and London purple did not kill enough to compare favorably with Paris green. The toxicity of the six insecticides to the sweet potato weevil was cal-green, London purple, barium fluosilicate, copper arsenate, sodium fluoride, and Paris green in the order named—sodium fluoride and copper arsenate having approximately the same toxicity as Paris green.

Since the poison baits seemed so promising in killing the adult weevils, experiments were begun to find a preservative which could be added to the bait and would prevent its spoiling and becoming unattractive to the weevils. Moulding of the bait seems to take place the first three or four days, or before it becomes dry and hard. If it escapes moulding before it dries out, it seems to be relatively safe from spoiling thereafter until it becomes moistened again. Rewetting would, of course, take place in the field by both dew and rains, and it seemed essential to add a preservative to the bait to protect it in the field and while it was in storage, before being applied.

Formaldehyde, glycerine, methyl cellosolve, and sodium benzoate were used as the preservatives in a number of tests. All of these materials exerted a marked preservative effect on the bait, but sodium benzoate seemed to possess the most favorable qualities as a preservative, and it was selected out of the four materials to use in further tests, and to de-

TABLE 13—SHOWING EFFECT OF VARIOUS CONCENTRATIONS OF PARIS GREEN IN SWEET POTATO WEEVIL BAIT*

Bait formula	No. of tests	No. of replications each test	Total No. weevils used	PERCENT MORTALITY AFTER 72 HOURS				Age of bait at close of experiment
				Test No. 1	Test No. 2	Test No. 3	Test No. 4	
No. 1—Grated sweet-potato, 20 gms.; Paris green, 1 gm.	4	3	120	90	90	93	80	27 days
No. 2—grated potato, 20 gms.; Paris green, 1 gm.; sodium benzoate, 0.32%	4	3	120	100	86	100	96	27 days
No. 3—grated potato, 40 gms.; Paris green, 1 gm.; sodium benzoate, 0.32%	4	3	120	96	100	96	100	27 days
No. 4—grated potato, 60 gms.; Paris green, 1 gm.; sodium benzoate, 0.32%	4	3	120	90	96	96	93	27 days
No. 5—grated potato, 80 gms.; Paris green, 1 gm.; sodium benzoate, 0.32%	4	3	120	100	93	96	93	27 days
No. 6—grated potato, 100 gms.; Paris green, 1 gm.; sodium benzoate, 0.32%	4	3	120	100	96	93	100	27 days
No. 7—check (no poison)	4	3	120	6	3	3	3	27 days

*Weevils in this test had free choice of either poison bait or fresh unpoisoned potato.

TABLE 14—SHOWING COMPARISON IN TOXICITY BETWEEN PARIS GREEN AND FIVE OTHER INSECTICIDES IN POISON BAIT AGAINST THE SWEET POTATO WEEVIL*

Bait formula	No. insects per test	Total No. insects used	Total No. dead after 72 hours	Percent mortality
Grated sweet potato, 20 gms.; cal-green, 1 gm.	20	80	41	51
Grated potato, 20 gms.; London purple, 1 gm.	20	80	47	58.7
Grated potato, 20 gms.; copper arsenate, 1 gm.	20	80	76	95
Grated potato, 20 gms.; sodium fluoride, 1 gm.	20	80	77	96.5
Grated potato, 20 gms.; barium fluosilicate, 1 gm.	20	80	65	81.5
Grated potato, 20 gms.; Paris green, 1 gm.	20	80	79	97.5
Check (no poison)	20	80	15	18.7

*The only food available in these tests was the poison baits.

termine the minimum percentage necessary to prevent spoilage. Table 15 summarizes the effect of various concentrations of sodium benzoate on the poison bait.

According to these experiments, a minimum concentration of 0.32 percent sodium benzoate in the poison bait was necessary to give adequate protection from mould under ideal conditions for development of the fungus.

This concentration of sodium benzoate did not have any repellant effect on the weevils in feeding tests.

TABLE 15—Showing Effect of Various Concentration of Sodium Benzoate as a Preservative in Poison Bait* (Temp. 80° F.)
(All baits were inoculated with soft rot fungi spores before tests were begun.)

Concentration of sodium benzoate in bait	Results (fungus growth)						
	1st day	2nd day	3rd day	5th day	10th day	13th day	14th day
.02 percent........	none	none	very slight	heavy	heavy	heavy	heavy
.04 percent........	none	none	very slight	heavy	heavy	heavy	heavy
.08 percent........	none	none	very slight	very slight	heavy	heavy	heavy
.16 percent........	none	none	none	indication	slight	medium	heavy
.24 percent........	none	none	none	none	none	none	indication
.32 percent........	none	none	none	none	none	none	none
.40 percent........	none	none	none	none	none	none	none
2.0 percent........	none	none	none	none	none	none	none
Check (no preservative)..	none	none	very slight	heavy	heavy	heavy	heavy

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*All tests were conducted in covered petri-dishes where the relative humidity was maintained at 100 percent or very close to that point, and the temperature controlled at 80° F.

SUMMARY

Results of several tests prove that out of several toxic materials tried, Paris green was the most toxic and most suited as the insecticide to use in sweetpotato weevil bait. Earlier formulae tried consisted of 20 parts of grated sweet potato and one part of Paris green, however, later experiments showed that almost as good results were secured when the formula was changed to 100 parts of potato to one part of Paris green.

A serious disadvantage to this bait was that in a very short while after preparation it moulded, when under the proper conditions for fungus growth. A mouldy bait is unattractive to the weevils. This disadvantage, however, was overcome by the addition of 0.32 percent sodium benzoate to the bait mixture. Bait containing the preservative may be stored until ready for use without spoilage. This preservative did not affect the attractiveness of the bait to the weevils in toxicity tests.

When the weevils had access to fresh potato during toxicity tests, it was found that the mortality rate was decreased slightly, but not to the extent that the weevils were not effectively controlled.

Peach Insects

C. O. Eddy

It appears from observations during the past that the destructive insect pests are most important limiting factors in the commercial and home gardening production of peaches in Louisiana. From observations thus far it appears that they are going to be extremely difficult to deal with, particularly from the standpoint of home gardening because of limitations of equipment and time to devote to the control of the pests. Experiments and observations have thus far indicated that one of the best preventive measures for many of the pests of peaches is good cultural treatment, i.e., planting on good soil, fertilizing generously, and pruning severely, so that the growth of the peach will always be vigorous and forced. As long as peach trees are growing vigorously, it is very difficult for insects such as the shot hole-borer and the lesser peach tree borer to make serious attacks on the growth of the peach tree. In a measure this is also true of the peach tree borer and the scale insects.

THE PEACH TREE BORER:

Experiments and experiences in Louisiana have now indicated that two methods of control of the peach tree borer are satisfactory. The older method of controlling the peach tree borer with paradichlorobenzene can be satisfactorily and safely applied to peach trees four years of age and older in Louisiana. The control of the peach tree borer by the use of ethylene dichloride emulsion, when properly made, has been satisfactory on trees of all ages including those from one to three years old. Some difficulties have been encountered with the emulsions when they were improperly made either by growers or by manufacturers.

SCALE INSECTS:

Two insecticidal control measures for the control of San Jose scale are now being used in most of the state of Louisiana. The most used insecticide is commercial oil emulsion which is diluted as the manufacturers direct. The tank-mixed oil emulsions have been successfully used in areas where the work has been carefully supervised either by the Experiment Station, by Home Demonstration Agents, or by County Agents. The use of lye for the control of San Jose scale is common in a number of orchards in Northwest Louisiana and in scattered orchards in various other parts of the State. In recent experiments set up by the Experiment Station, it has been shown that this spray is safe on trees and that it gave control of scale insects in most cases. At Baton Rouge, Louisiana, there have been a number of cases of scale control where the lye has not given as good control as the oil emulsions. But in no instance has there been any injury to the trees, even when the dosage has been stepped up from the normal satisfactory dosage of a pound of lye to eight to 10 gallons of water to a pound of lye to five to six gallons of water.

ORIENTAL FRUIT MOTH:

The history of the Oriental fruit moth in Louisiana appears in *Entomological Progress* Number 2, *Louisiana Agricultural Experiment Station Bulletin* Number 323. Colonies of parasitic wasps, which destroy the larvae of the Oriental fruit moth, were imported during the summer of 1940 and again during the summer of 1941. It had previously been determined that these beneficial parasites were not present in Louisiana.

The importation of these parasites should be continued during the next several years.

As a pest of the twigs and fruits of peaches in Louisiana, the Oriental fruit moth possibly has not yet reached its greatest destructiveness, since it has only been here for the last five or six years. In Northeastern Louisiana the pest causes important losses each year, whereas in Northwestern Louisiana and in Central Louisiana it causes important losses to the fruit about one year in every three years.

PLUM CURCULIO:

The curculio seems to be controlled in fruit by a rather moderate spray schedule such as is given in *Insect Pest Control Service Leaflet,* Number 9.

Notes on the Reaction of the Sweet Potato Weevil Under Different Qualities of Light

Louisiana Agricultural Experiment Station

The effect of various light rays on the reaction of the sweet potato weevil, *Cylas formicarius* Fab. was studied in a preliminary manner during the latter part of 1939 and early in 1940. The first light reaction tests were conducted in an effort to determine the effect of different light rays on feeding and oviposition. These tests were performed by L. D. Newsom, student in entomology working under the direction and supervision of C. O. Eddy of the Louisiana Agricultural Experiment Station, and L. H. Flint of the Botany Department, Louisiana State University.

TEST NUMBER 1:

The rays of a selective spectrum were focused in the bottom of a shallow white enamel pan, 12 inches by 18 inches. Five potato vines were then placed at equal distances apart, the entire width of the pan. Forty weevils were released in the pan and a plate glass placed over it. This setup was under observation during the test, and after the test was discontinued, the actual number of feeding scars were counted on each vine. This experiment was replicated five times and similar results were secured each time. Observations and counts showed the greatest response by the weevil for the violet end of the spectrum, followed by the blue, red, orange, yellow, and green, respectively. However, very little feeding occurred in either the red, orange, yellow, or green portions.

TEST NUMBER 2:

Test Number 2 consisted in determining the weevil response when they were exposed to the ultra-violet ray. Six test tubes about seven inches long were wrapped one-half their length with black photographic paper, while the other half of each tube was left bare. A potato vine the length of the tube and ten adult weevils were placed in each. These were then exposed to ultra-violet rays. The test was replicated four times, and it was found that practically no feeding occurred on the exposed section of the vine, while heavy feeding took place on the portion shielded by the paper.

TEST NUMBER 3:

This experiment consisted in comparing the preference by the weevil for feeding and ovipositing in blue light and in red light.

A battery jar, 6 inches x 10 inches x 4 inches was wrapped on all sides with black photographic paper, leaving only the top open. A small potato was cut in half lengthwise, and a piece placed at each side of the jar bottom. One hundred weevils were then released in the jar, which was covered by a strip of blue cellophane over one-half and red cellophane over the other half.* The jar was then placed directly under a 300 watt electric bulb at a distance of five feet from the jar. This setup gave one half of the jar in red light and the other half in blue light, and a piece of potato in each one of the two colors. The test was conducted at 80° F. throughout. The two pieces of potatoes were removed daily and examined for feeding punctures and for oviposition, a new piece of potato being supplied each day.

Table 16 shows the marked attractiveness to the weevil of red light over blue for both feeding and oviposition. Over a period of six days, with daily examinations, approximately 5.8 times as many feeding punctures and five times as many eggs were found in the red light as were found in the blue light.

TABLE 16—SHOWING EFFECT OF TWO QUALITIES OF LIGHT ON FEEDING AND OVIPOSITION BY THE SWEET POTATO WEEVIL (Temp. 80° F.)

Date	BLUE LIGHT		RED LIGHT	
	Feeding	Oviposition	Feeding	Oviposition
10-26-39	60	10	209	33
10-27-39	44	24	81	33
10-28-39	28	3	268	57
10-29-39	7	3	265	61
10-30-39	19	6	140	43
10-31-39	29	10	116	57
TOTAL	187	56	1079	284

TEST NUMBER 4:

This experiment was designed to test the effect of light on the rate of feeding.

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* The cellophane used was of a standard design which transmits a constant quality of light.

One hundred and fifty weevils, two-thirds of which were females, were placed in each of two battery jars. Two small uniform potatoes were selected and one placed in each of the jars. One jar was then wrapped securely with black photographic cloth to exclude the light, while the second jar was left exposed. This experiment was replicated five times for periods ranging from two to 10 hours. The light was excluded from each jar alternately, and the test conducted under a controlled temperature of 80° F.

The weevils fed considerably more in the dark than they did in the light. Feeding punctures in the light counted 385 as compared to 600 punctures in the dark over the same period of time. Table 17 gives the results of each feeding test.

TABLE 17—SHOWING EFFECT OF LIGHT ON RATE OF FEEDING. TEMP. 80° F.

Date	Number weevils in test	NUMBER OF FEEDING PUNCTURES	
		In light	In darkness
12-10-39	150	28	47
12-11-39	150	107	125
12-12-39	150	25	50
12-13-39	150	157	252
12-14-39	150	68	126
TOTAL	150	385	600

TEST NUMBER 5:

This test was a continuation of the previous ones on the effect of different qualities of light on feeding and oviposition, except a different technique was employed. A weevil-proof box 18 inches x 14 inches x 4 inches deep was constructed of wood and lined with heavy black cloth. Pieces of transparent, red, and blue cellophane and a piece of thick, black photographic paper were cut in equal sizes and pasted together. The top of the box was covered with this so that each quarter of the box was covered by one of the four materials. Pieces of potato were cut so that the weevils could feed and oviposit only on the surface exposed to the quality of light immediately above it. One piece of potato was placed in each corner, or square, of the box and a number of weevils released in the center of the box. The top was securely fastened, and the box placed directly beneath a 100 watt light five feet above it. The experiment was conducted at 80° F. The pieces of potato were examined daily for feeding punctures and number of eggs deposited. The test was continued over a period of 13 days. The weevils showed great activity in the dark area, with red, transparent and blue following in the order named. There were a total of 1997 feeding punctures in the blue light, 4059 in the transparent area, 8525 in the red, and 12,830 in the dark; and a total of 117 eggs deposited in the blue light, 312 in the transparent area, 795 in the red, and 1529 in the dark. Table 18 gives the detail results of the test.

TABLE 18—Showing Reactions of Sweet Potato Weevils in Four Different Qualities of Light (Temp. 80° F.)

	Blue Cellophane		Transparent cellophane		Red cellophane		Black photographic paper	
Date	No. of feeding punctures	No. of eggs deposited	No. of feeding punctures	No. of eggs deposited	No. of feeding punctures	No. of eggs deposited	No. of feeding punctures	No. of eggs deposited
1-15-40	342	5	489	6	1229	87	2200	89
1-17-40	312	7	502	35	1047	118	2047	184
1-18-40	414	18	918	71	1877	135	3745	330
1-25-40	221	16	504	12	985	47	1027	146
1-26-40	429	38	753	63	1536	180	1733	340
1-28-40	279	33	893	125	1851	228	2078	440
Total	1997	117	4059	312	8525	795	12830	1529

Discussion of Results:

These light reaction experiments, though of a preliminary nature, showed that the activities of the sweet potato weevil adult were markedly influenced by different qualities of light.

In test Number 1 where the weevils had free choice of feeding in any color of the spectrum, they fed more at the violet end. In this test, using the spectrum to obtain light quality, next to the violet ray the weevils were more acive in blue light than they were in red light; whereas, in test Number 5 where blue, red, transparent, and complete darkness were given for their choice, the weevils showed less activity in light than they did in the red or the other light qualities. This is perhaps partially explained by the fact that the blue light and red light in test number 5 were obtained from a light prism.

In all cases the weevils fed more and oviposited more in the dark than they did in the light or in any single color. Under different qualities of light obtained by transmitting ordinary light through selected colors of cellophane, the sweet potato weevils were more active in the red color than they were in the blue. However, the reverse was true when the two colors were obtained from a light prism.

Oviposition in all tests was in proportion to the amount of feeding done. When little feeding was done, very few eggs were deposited; and when heavy feeding occurred, many eggs were deposited. That is, the light color or ray does not affect one of these factors without influencing the other.

The Sand Wireworm

C. O. Eddy
Louisiana Agricultural Experiment Station

During the last two years preliminary observations and studies have been made on the sand wireworm in the Bienville-Red River Valley section. A few of the facts that have been discovered are discussed here.

It has been found, for instance, that for all practical purposes the damage of the sand wireworm was completed during the third week in June. This indicates that seeds can be planted during the last 10 days of June instead of waiting until July 10, as has heretofore been recommended when wireworm susceptible crops are used. The growers believe that this advance in planting date for late crops will make it possible to utilize a number of crops successfully that have not been grown without severe damage in that section before.

The rotations that have been worked out by the United States Department of Agriculture and reported in Technical Bulletin No. 659 give certain rotations that involve the planting of summer crops in July. In the sandy area where the wireworm is destructive in Louisiana, crops will not grow due to the long, dry hot spell which even causes failure of late planted crops such as soybeans. For that reason, the rather complicated rotations which have been advocated in this technical bulletin are not being used and do not seem, at the present time, to offer the solution to the wireworm problem. The rotation problem in the sandy hills of Louisiana must of necessity be reduced to simple yearly rotations, to the use of winter cover crops and to the use of wireworm resistant food and feed crops. Work and observations during the last few years have shown that plants such as oats, vetch, crimson clover and lespedeza are the most promising fodder crops and that peanuts and sweet potatoes offer excellent possibilities for money, food and feed crops with little or no damage from the wireworm.

The most imperative practice seems to be the release of lands from cotton or corn, planting these lands to wireworms resistant crops or leaving them fallow for one or two years. Observations during the last several years have shown that where wireworm infestations are light that this rotation can be for only one year. Where the infestation of wireworms runs from moderate to heavy, it is necessary that these lands be not planted to cotton or corn for at least two years.

In the experiments using poisons such as beta-naphthol, paradichlorobenzene, and poison baits, such as bran baits containing Paris green, calcium arsenate, or sodium fluosilicate, damage to the plants resulted in every instance. Experiments with emulsified dichloroethylether in water solution, however, gave control of the wireworms without injuring either cotton or corn. Whether a practical and satisfactory method of utilizing this chemical in the control of the sand wireworm can be worked out remains to be determined by future experiments.

Potato Tuber Injury

C. O. Eddy
Louisiana Agricultural Experiment Station

In Louisiana and a number of Southern States there is now appearing an injury to the tubers of Irish potatoes known as heeled-hole injury. Very little definite information is available on this injury, but from general observations it appears that most of the small heeled-holes are caused by the larvae of diabrotica. This statement is supported by a number of facts.

First, the diabrotica larvae have been found in a number of these tunnels during the last three years. Second, tests where diabrotica beetles were confined in cages over potato plants during two different seasons showed an increase in this type of injury over adjacent plants grown in the same field; and during one season, in addition to the two seasons already mentioned, the crop of potatoes was very greatly reduced where these beetles were confined in cages over the plants during the early stages of growth.

Then there are the large surface erosions which are caused by insects such as white grubs and mole crickets. Of course, the tunneling under the skin of the potato that is caused by the potato tuber moth is quite distinct from any injury mentioned above. This injury is localized.

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LOUISIANA BULLETIN NO. 351 JUNE, 1942

THE BATON ROUGE CITY ABATTOIR: RELATION TO THE RETAIL MEAT SUPPLY, PRODUCTION AND MARKETING PROBLEMS OF FARMERS

BY

J. M. BAKER

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The Baton Rouge City Abattoir: Relation to the Retail Meat Supply, Production and Marketing Problems of Farmers

BY

J. M. BAKER*

INTRODUCTION

The City Abattoir at Baton Rouge began operation in September, 1915, and is one of 25 municipally owned and operated slaughterhouses in the United States. There are only three abattoirs with a longer period of service. The older abattoirs are located at Paris, Texas; Charleston, South Carolina; Beaumont, Texas, and began operations in 1909, 1912 and 1914 respectively.[1]

The plant at Baton Rouge was organized under the leadership of Dr. W. H. Dalrymple, formerly head of the Department of Veterinary Science at the Louisiana State University. The members of the City Commission of Baton Rouge at the time were Alex Grouchy, Mayor; L. J. Ricaud, Commissioner of Finance; and George W. Garig, Commissioner of Streets and Parks. Dr. J. I. Martin was the first inspector and he was also the manager from April 1921 to June 1941.

The City of Baton Rouge financed the first building by issuing $12,000 in certificates of indebtedness. The volume of business soon exceeded the capacity of the cooler and the plant was expanded in 1917 at a cost of $25,000. Again the demand outgrew the facilities and a $45,000 bond issue was voted by the people of Baton Rouge in 1925 to provide the plant in operation in 1941. The Abattoir, including the site, was valued at approximately $50,000 in 1941. The plant is located at 2120 Convention Street on a small lot 122.5 feet wide and 300 feet deep.

PURPOSE OF STUDY AND SOURCES OF INFORMATION

The purpose of the study is to ascertain the extent to which the Baton Rouge Abattoir has achieved the objectives for which it was established; to show its relation to the retail meat supply and to the local livestock industry; to give information which would help to determine whether the plant should be continued in operation; and to show the advantage of uniting the operation of the Abattoir with other marketing units needed by the farmers.

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* The following persons supplied information on the City Abattoir: Dr. J. I. Martin and Miss Eliska Kleinpeter at the Abattoir, and Messrs. W. H. Perkins, N. L. Dupuy, Geo. F. Brogden, Jesse L. Webb, and W. S. Day at the City Hall. Warren Savant and Herbert Blanchard assisted in compiling the statistical data.

[1] "Slaughterhouses" in Local Government Administration, December, 1936, pp. 235-240 and also *The Municipal Review* (England) June, 1936, pp. 175-176.

The study comprises an analysis of the operation of the Abattoir in Baton Rouge and a comparison of certain aspects of its operating experience with those of four other municipal abattoirs. The outside plants are located at Austin, Beaumont, Paris and Temple, Texas. The abattoir at Austin is the largest municipally owned and operated slaughterhouse in the United States. Though erected in 1931 at a cost of $102,000, it was found desirable to build an additional cooling room in 1936. The plant at Beaumont was constructed in 1914 and the original facilities were reported as still satisfactory in 1940. Paris, the first city in the United States to establish and operate an abattoir, replaced the old plant in 1937 with a new structure and modern equipment through cooperation with the Works Progress Administration. Temple has a small plant built in 1928 which is still in good condition.

Information was obtained from forty-six local meat dealers concerning the sources of their meat supply and their opinions of the value of the Baton Rouge City Abattoir to the meat trade, the farmer and the consumer. Twenty-two of the dealers were located within the city limits and twenty-six outside the city limits. Data concerning the operation of the City Abattoir were obtained from the manager of the Abattoir and from records on file at the City Hall. Personal interviews with managers of abattoirs and with local meat dealers were used as a means of obtaining information from them.

OPERATIONS OF THE BATON ROUGE ABATTOIR

Volume of Slaughter

The number of each kind of livestock slaughtered in the City Abattoir by years from 1915 to 1941 is shown graphically in Figure 1. There was a rapid upward trend in volume of business from 1915 until 1923. Following 1923 the volume of business declined sharply until about 1934. Since 1934, there has been some increase in the volume of calves, yearlings and hogs slaughtered but the general level of slaughter has remained relatively low as compared with 1923.

Data on the volume of business in the Texas plants show that the Baton Rouge plant slaughtered less cattle during 1939 than any one of the four plants in Texas (Table 1). The Baton Rouge plant ranked second in the number of calves slaughtered, fourth for hogs and fifth for sheep and goats.

The decline in volume of business in the Baton Rouge City Abattoir appears to have been associated with the following factors: (1) the growth of chain stores which use a higher percentage of packer products

CALVES, YEARLINGS, BEEVES, HOGS AND SHEEP SLAUGHTERED ANNUALLY, BATON ROUGE CITY ABATTOIR, 1915-1941.

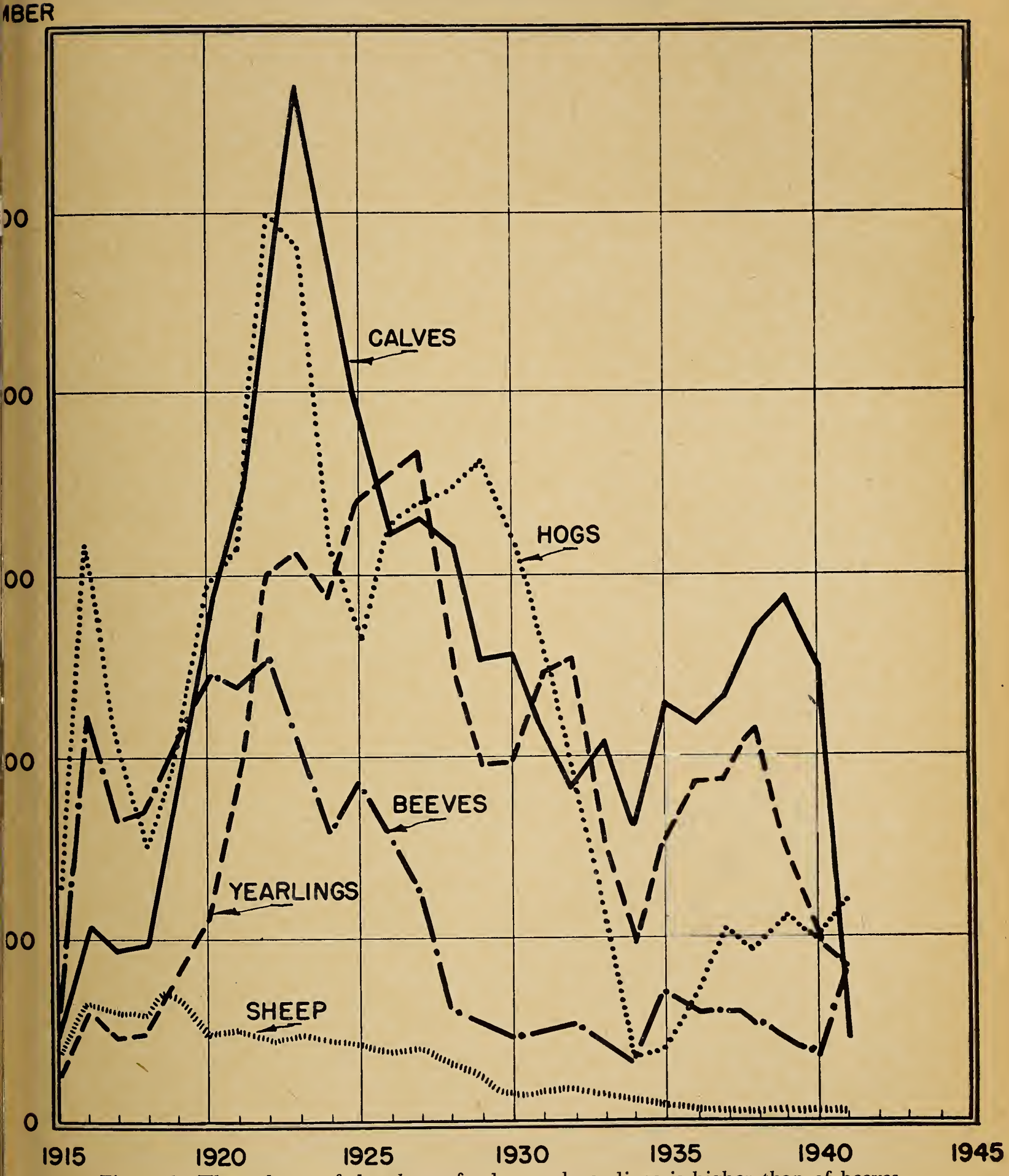

Figure 1. The volume of slaughter of calves and yearlings is higher than of beeves. Heavy beef meat is largely imported from areas where concentrated feeds are produced abundantly. The relatively large slaughter of hogs between 1920 and 1930 was associated with a local interest in sausage making. Lack of substantial recovery in volume of business during the thirties may be attributed to factors which affected the operations of the Abattoir. The local supply of sheep produced for the meat trade declined from 1919 to 1930 and continued at a low level during the last decade.

TABLE 1. CATTLE, CALVES, HOGS AND SHEEP SLAUGHTERED AT BATON ROUGE CITY ABATTOIR COMPARED WITH FOUR PLANTS IN TEXAS.

PLACE	SLAUGHTER IN 1939 OF			
	Cattle	Calves	Hogs	Sheep*
	(Number)	(Number)	(Number)	(Number)
Baton Rouge	1,899	2,872	1,168	17
Austin	20,318	1,147	7,969	688
Beaumont	2,637	6,747	8,153	242
Paris	2,070	478	2,635	85
Temple	4,043†	......	1,000	384

*Includes a few goats. †Includes calves.

than do independent stores;[1] (2) laxity in the enforcement of inspection laws which gradually permitted the entrance of ineligible products; (3) the growth of suburban population and the establishment of retail meat stores outside of the city limits and hence not under the control of city officials; and (4) better roads and more trucks, which under conditions of lax enforcement of sanitary regulations, encourage dealers to slaughter elsewhere and transport meat instead of live animals.

Underemployment did not cause the lower volume of business following the year 1926. Other municipal abattoirs operated successfully during the depression of the 1930's and periods of low prices for livestock should tend to encourage local slaughter, because transportation costs become a relatively higher proportion of the retail cost of meat as the price paid for livestock declines.

Cash Earnings and Expenses

During the 13 years of operation following 1915, the Baton Rouge plant had an average gross cash gain of about $4,652 per year over cash expense of operation. The large profits in 1922 and 1923, as shown in Table 2, were largely due to an increased volume of slaughter which was handled without increasing expenses as much as earnings. The large earnings made in 1926 were partially accounted for by a higher than usual price received for by-products during that year. There was a precipitous decline in earnings in 1927 and in 1928. The record of earnings in comparison with expenses for the 13 years following 1928 is unfavorable. From 1929 through 1941 there was an average cash loss of $4,214 per year, and an annual deficit occurred in every year from 1929 through 1941.

A former Commissioner of Finance, when asked about the deficits, said the City Abattoir was not operated for profit but to render the community a health service. He contended that the community did not sustain a net loss, since competition with packers through the use of the Abattoir by dealers is reflected in lower meat prices for Baton Rouge. Many dealers were of the same opinion. The city officials are working on the problem of keeping cash expenses in line with cash earnings, and some changes were made during 1941 for the purpose of reducing losses in operation.

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[1] Chain stores in Baton Rouge and suburbs increased from 5 in 1924 to 30 in 1930. Since 1930 many chain units have been consolidated but the proportion of meat sold by chain stores has steadily increased.

TABLE 2. ANNUAL CASH EARNINGS COMPARED WITH ANNUAL EXPENSES, BATON ROUGE CITY ABATTOIR, 1915-1941.

YEAR	Annual cash earnings	Annual expenses	Annual gain or loss
	(Dollars)	(Dollars)	(Dollars)
1915*	4,199	4,191	8
1916	12,373	9,430	2,943
1917	11,485	7,492	3,993
1918	9,371	9,687	– 316†
1919	13,928	13,010	918
1920	21,141	19,721	1,420
1921	23,202	19,480	3,722
1922	32,407	19,954	12,453
1923	31,464	21,793	9,671
1924	25,867	20,408	5,459
1925	26,270	22,160	4,110
1926	35,210	22,660	12,550
1927	27,588	24,231	3,357
1928	19,570	19,369	201
1929	16,654	17,502	– 848
1930	14,542	17,912	– 3,370
1931	14,237	16,924	– 2,687
1932	12,355	14,991	– 2,636
1933	9,932	11,877	– 1,945
1934	6,261	12,431	– 6,170
1935	10,328	13,926	– 3,598
1936	10,321	18,194	– 7,873
1937	12,649	16,424	– 3,775
1938	11,766	17,313	– 5,547
1939	11,288	15,155	– 3,867
1940	8,216	14,762	– 6,546
1941	10,455	16,378	– 5,923
TOTAL FOR PERIOD	443,079	437,375	5,704

*September through December.
†Not a real loss, but due to lack of posting before end of 1917.

Data on earnings are available for the year 1939 for three of the four abattoirs in Texas. They compare with the Baton Rouge plant as follows:

PLACE	Earnings	Expenses	Gain or loss
Baton Rouge	$11,288	$15,155	$ 3,867–
Austin	61,671	53,105	8,566
Paris	10,693	10,551	142
Temple	7,430	6,230	1,200

It would appear that while all of the Texas abattoirs made some profit in 1939, the margin between earnings and expenses was not large at either Paris or Temple where the volume of business was small. At Austin, where 20,318 cattle and 7,659 hogs were slaughtered, there was a cash gain of $8,566, while Baton Rouge had a loss of $3,867.

Amount and Sources of Earnings

For the period from 1916 through 1940, 83 per cent of the cash earnings of the Baton Rouge plant was from slaughter fees and 17 per cent from the sale of by-products (Table 3). The main by-products are tankage, tripe and tallow, and these three items account for more than 90 per cent of the income from by-products. (See Appendix Table A.)

TABLE 3. OPERATING EARNINGS OF THE CITY ABATTOIR FROM SLAUGHTER FEES AND SALE OF BY-PRODUCTS, FIVE-YEAR PERIODS, 1916-1940.

FIVE-YEAR PFRIOD	Earnings	EARNINGS FROM			
		Slaughter fees		Sale of by-products	
	(Dollars)	(Dollars)	(Per cent)	(Dollars)	(Per cent)
1916-20	68,298	46,992	68.8	21,306	31.2
1921-25	139,210	114,695	82.4	24,515	17.6
1926-30	113,564	93,806	82.6	19,758	17.4
1931-35	53,113	48,833	92.0	4,281	8.0
1936-40	54,240	48,653	89.6	5,587	10.4
TOTAL	428,425	352,978	83.0	75,447	17.0

The earnings of an abattoir depend almost entirely upon fees received for slaughter and the sale of by-products made from materials resulting from slaughter but not returned to the persons who supply the livestock. Both the amount of fees received and of by-products to be sold depend largely on the number, size, and kinds of animals slaughtered. The fees charged for slaughter at Baton Rouge and the four municipal plants in Texas are given in Appendix Table B. The data show some variation in charges per head for slaughter, but the differentials are due to a considerable extent to variation in the amount of service given. The plant at Baton Rouge furnishes a full-time delivery service, the plant at Paris one delivery per day, while Austin and Temple do not furnish any delivery service. Many other differences in amount and quality of services given to customers were observable.

Operating Expenses

About two-thirds of the expenses of operating the Baton Rouge City Abattoir were for salaries and wages and one-third for miscellaneous operating costs (Table 4). Salaries and wages include payments to the manager and all other employees. Other operating costs consist largely of supplies, repairs to tools, equipment, electricity for power, light and refrigeration, gas for heat, trucks for delivery service, containers, and insurance. The historical data indicates that when the volume of the business was trending upward, or maintained at a comparatively high level, cash expenses were more than covered by earnings.

TABLE 4. CASH EXPENSE OF OPERATION BY FIVE-YEAR PERIODS, BATON ROUGE CITY ABATTOIR, 1916-1940.

FIVE-YEAR PERIOD	Expense	CASH EXPENSE FOR			
		Salaries and labor		Other operating expense	
	(Dollars)	(Dollars)	(Per cent)	(Dollars)	(Per cent)
1916-20	59,341	45,030	75.9	14,310	24.1
1921-25	103,795	70,580	68.0	33,215	32.0
1926-30	101,674	67,513	66.4	34,162	33.6
1931-35	70,150	49,397	70.4	20,753	29.6
1936-40	81,849	48,151	58.8	33,698	41.2
TOTAL	416,809	280,671	67.4	136,138	32.6

Since many of the fixed charges such as interest on investment and depreciation are not included in the costs considered here, a continuous deficit from 1929 to 1941 cannot be justified because of the lower volume of business as compared with earlier years. Cash costs should have been lowered more than they were. The data in Table 4 show that the management was able to lower the percentage of earnings spent for wages from 68 per cent during the period 1921 to 1925 to 58.8 per cent during the period 1936-40, but it was unable to keep other cash operating expenses from increasing from 32 during the former period to 41 per cent during the latter period. It is not known why operating costs for items other than labor were at peak levels during the last five-year period shown in Table 4. The conclusion is that the management was unable to make the adjustments that were needed.

USE OF ABATTOIR BY RETAIL MEAT DEALERS

Local meat dealers within the city limits reported obtaining 16.8 per cent of their meat supply through the City Abattoir in Baton Rouge, whereas dealers outside the City limits obtained only 14.5 per cent from

TABLE 5. SOURCE OF RETAIL MEAT SUPPLY, BATON ROUGE AND ENVIRONS, OCTOBER, 1940.

NUMBER AND LOCATION OF MARKETS	PERCENTAGE OF MEAT SUPPLY OBTAINED FROM			
	City Abattoir	National packers	Local packers	Other sources*
	(per cent)	(Per cent)	(Per cent)	(Per cent)
22 within city	16.8	66.3	16.9	0
24 outside of city	14.5	43.6	35.8	6.1

*Individual slaughter plants, on farms, in woods, pastures, etc.

the City Abattoir (Table 5). Six per cent of the total amount handled by the dealers located outside of the city limits was slaughtered either in the woods, on a farm, or in a private slaughter shed maintained by some individual. The data in Table 6 show that more than half of the local dealers did not use the City Abattoir for slaughter at all in 1940. No dealer within the City, however, reported slaughtering animals other than at the local plant.

TABLE 6. REPORTED USE OF CITY ABATTOIR BY LOCAL RETAILERS, 1940.

EXTENT OF USE OF CITY ABATTOIR	LOCATION OF RETAILER			
	Within City		Outside City	
	(Number)	(Per cent)	(Number)	(Per cent)
Over 50 per cent from Abattoir	4	18	6	25
Less than 50 per cent	9	41	10	42
Did not use at all	13	59	14	58
Slaughtered on farms, or in woods, etc.	0	0	4	17

Those retailers who buy livestock and have it slaughtered at the Abattoir were of the opinion that this procedure provides good meat at lower cost to the consumer and also helps to encourage the local farmer to produce more livestock. The desire to encourage local farmers to produce more and better livestock and to help consumers obtain as much meat as possible for the money they have to spend for that purpose is laudable and should receive careful consideration.

The reasons most frequently given by retailers for not patronizing the Baton Rouge City Abattoir were: (1) It is less trouble to buy from packers; (2) customers demand packing house meats from the grain belt; (3) the packer furnishes the particular cuts of meat in the proportions demanded by the consumers; (4) too much cash is required when livestock is purchased directly from farmers; and (5) the local supply of animals fit for slaughter is not sufficient to supply needs at certain times of the year.

Many retailers do not want to bother with selecting and purchasing animals to be slaughtered for them in the City Abattoir. Some of them said they were not trained to judge the quality of meat by the appearance of the live animal. The selection and purchase of live animals takes considerable time and also slaughter through the Abattoir requires the retail sale of the various cuts of meat in the proportions found in the carcass, while customers of any one shop may demand them in some other proportion. For these reasons, some retailers believe it is cheaper and more convenient for them to buy from the packer.

The fact that customers frequently call for Kansas City meat indicates that the consumers either think the quality of grain-belt meat is better or they feel that local meat may not have been properly inspected at the time of slaughter and therefore reject it because of this uncertainty.

SANITARY CONDITIONS

It is a violation of the sanitary regulations of the City of Baton Rouge to sell meat in retail shops that has not been slaughtered in the City Abattoir or in a plant that is under federal inspection, unless it has been passed by the City Abattoir Inspector (Appendix B). For meat to pass inspection in Baton Rouge, the place of slaughter must conform to standards and regulations equal to those prescribed for the City Abattoir. However, 8 dealers within the City and 2 dealers outside the city limits reported that meat which had undergone no kind of sanitary inspection whatsoever had been sold within the City, especially to boarding houses and restaurants. Such conditions not only make the successful operation of the City Abattoir more difficult, but also fail to give the health protection which Baton Rouge citizens have a right to enjoy.

According to city sanitary regulations, all meant and meat products not bearing the federal inspection stamp shall be inspected by the Inspector of the City Abattoir. This part of the regulation is not only being grossly violated but appears to be completely ignored in many cases. Besides affecting greatly the volume of slaughter at the City Abattoir, the lack of enforcement of the ordinance is unfair to those local dealers who faithfully observe it. Nearly 50 per cent of the community's population live in subdivisions and patronize markets not affected by the city's slaughter regulations. If a sanitary slaughter code is good for part of the Baton Rouge community, it is good for all, and that part not under the supervision of the City Commission should receive the attention of parish officials.

WHY THE CITY ABATTOIR IS NEEDED

There are two ways to get livestock from the farm producer to the retail meat market. One is by way of the packing house; the other is direct from the farmer to the local meat dealer. The former has the advantage of less loss in by-products and the latter has less cost in transportation and overhead. The systems are highly competitive in Louisiana. Wholesome competition and healthful products are both desirable and public officials should maintain and enforce regulations which would require all meat products to meet a high sanitary standard, and keep them on a fair, competitive basis. Since some local slaughter is certain to take place, it is necessary to centralize this slaughter in order to have effective inspection. It is necessary to consolidate slaughter at one place, such as the City Abattoir, since each local dealer cannot afford to maintain a suitable abattoir for his individual business.

Though Louisiana produces much good livestock for slaughter, it is a deficit area for quality meat and therefore large quantities are imported. This situation offers advantages for building and maintaining markets for local products. The factor most essential in establishing a good market for any product is complete confidence of the consumer in that product. Confidence in meat is based mainly on sanitation, and the first step in procuring a sanitary meat supply is sanitary slaughter.

Centralized slaughter in France and Germany is done almost entirely at public abattoirs. In Berlin and Vienna slaughtering at municipal abattoirs is compulsory. The largest cities in England have established such plants, and small private slaughterhouses are fast disappearing.[1]

It is both difficult and expensive to supervise slaughtering at a number of small isolated establishments. If a municipality is to protect the health of its people, it must demand that certain minimum regulations be rigidly maintained wherever animals are slaughtered for sale. In order to regulate local slaughter at reasonable expense, some means must be provided for centralizing it into one establishment, especially equipped for handling and storing meats.

COOPERATIVE ORGANIZATION WOULD HELP SOLVE THE ABATTOIR PROBLEM

A modern farmers' market is needed in Baton Rouge and might logically take over the abattoir as one of the major service units in a greatly expanded organization which would provide the best market obtainable for any product farmers want to produce and sell and also help them reduce the cost of purchasing fertilizer and other supplies, tools, equipment and machinery used in farm production. The abattoir facilities would constitute an effective unit with which to start and one which could serve as a nucleus in building a coordinated marketing program for the community.

The type of organization suited to such an enterprise is a cooperative, either a cooperative controlled entirely by the members, or a quasi cooperative controlled and operated jointly by the City and the patron members of the organization.

The proposed farmers' market would have two main objectives: (1) the assembling of farm products in sufficient volume for economical grading and selling; and (2) to provide service in buying farm supplies and equipment. By combining "Across the Board" services in buying supplies needed by them and in selling their products, there would be sufficient volume of business to enable the organization to hire a capable and efficient manager. One large organization would be more efficient in meeting competition than individual units operating on a small scale.

Some of the units of activity that could be established under the suggested plan are:

1. *The City Abattoir.* The services to be provided by this unit have been delineated.

2. *Frozen-Food Locker and Meat Curing Service.* The services of this

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[1] "Slaughterhouses" in Local Government Administration, December, 1936, pp. 235-240, and also *The Municipal Review* (England) June, 1936, pp. 175-176.

unit are needed and logically would be the first unit to be added to the abattoir nucleus.

3. *Poultry, Dairy and Vegetable Unit.* This unit would assemble and provide a sales organization for farm products such as poultry, eggs, milk, cream, fruit, vegetables, or other products the farmers might want to offer for sale.

4. *Supply Unit.* Most farmers are familiar with the practicability of buying cooperatively such items as wire fencing, milk cans, baby chicks, and the like. Feed, seed and fertilizer are well adapted to cooperative purchasing. Much coordination could be had with the abattoir unit in mixing feeds and fertilizers. There should be a grinding and mixing machine so many locally grown feed crops might be utilized to better advantage.

5. *Transportation Unit.* Delivery service, though a part of every department, is highly important and would need to be adequate and well coordinated among the departments. Many people are not aware of the extensive demand for "curb service" by small producers and small consumers.

6. *Credit Unit.* Among small producers and dealers, credit, especially short-term credit, is an essential. This service might be supplied through a cooperative credit union, the Bank for Cooperatives, the Farm Security Administration, and local banks. The credit unit would coordinate the services of the various credit agencies and make them available to all members.

Obviously, an organization similar to the one outlined above is needed in many localities in Louisiana and in the farming sections of many other states. The first step toward organizing a cooperative farmers' buying and selling organization would be to survey the territory to be served and ascertain the extent of the needs for the enterprise and the willingness of the farmers to participate.

SUMMARY AND CONCLUSIONS

1. Although the Baton Rouge City Abattoir has operated at a loss during recent years, this does not mean it is out of date. Such an institution is needed to protect consumers from contaminated and diseased meat and to encourage trading between local farm producers and meat dealers. The local slaughter of livestock and the sale of meat resulting therefrom cannot be stopped by discontinuing the Abattoir. It would, however, make the control of sanitation and inspection of local meat offered for sale much more difficult.

2. The Abattoir Ordinance is rather complete in its provisions to provide for Baton Rouge a meat supply which is wholesome and sanitary, and no revision should be made which would lower the sanitary standards prescribed therein. However, the Police Jury of the Parish should

extend the Ordinance to cover conditions outside of Baton Rouge. Many changes in local conditions have taken place since the Abattoir was established. It should be moved to a more suitable location and its services to the community should be expanded.

3. The problem of operating the City Abattoir on a self-sustaining basis is mainly one of increasing the volume of slaughter and reducing the cash expense of operation. Volume can be increased by (1) strict enforcement of the provisions of the Abattoir Ordinance enacted by the City Commission; (2) extension of the area covered by this Ordinance to include the subdivision outside the city limits; and (3) encourage better trade relations between producers and retailers in the community through leadership to be given by the manager of the City Abattoir.

4. Cash expenses of operation in relation to earnings of the Abattoir should be balanced by better management. Through using the plant as a nucleus for developing a comprehensive farmers' buying and selling cooperative, better management could be provided at a lower cost to the Abattoir. In addition, the proposed cooperative enterprise would enlarge the opportunity of the Abattoir to be of service both to the farmers and to the consumers of meat in Baton Rouge and its environs.

APPENDIX A

TABLE 1. VALUE OF BY-PRODUCTS, BATON ROUGE CITY ABATTOIR, 1922-1941*

YEAR	Total value by-products	TANKAGE		TRIPE		TALLOW		OTHER†	
		Value	Per cent of total	Value	Per cent of total	Value	Per cent of total	Value	Per cent of total
1922	$ 6,098.49	$ 1,630.18	26.7	$ 604.56	9.9	$ 3,800.37	62.3	$ 63.38	1.1
1923	4,959.55	1,570.35	30.5	494.67	9.7	2,869.53	59.3	25.00	0.5
1924	4,604,89	1,490.32	32.4	536.52	11.7	2,578.05	55.9	....	....
1925	4,906.06	1,049.50	21.4	476.36	9.7	3.348.00	68.2	32.20	0.7
1926	6,868.71	1,731.66	25.2	2,117.85	30.8	3,019.20	44.0	....	....
1927	6,253.90	1,907.01	30.5	1,802.14	28.8	1,737.27	27.8	807.48	12.9
1928	3,073.81	981.79	31.9	890.16	29.0	1,201.86	39.1	....	....
1929	2,361.32	984.00	41.7	627.97	26.6	....	....	749.35	31.7
1930	1,200.50	642.20	53.5	558.30	46.5	....	....	....	....
1931	908.75	485.00	53.4	423.75	46.6	....	....	....	....
1932	488.99	229.75	47.0	259.24	53.0	....	....	....	....
1933	954.00	515.75	54.1	438.25	45.9	....	....	....	....
1934	562.20	169.50	30.2	392.70	69.8	....	....	....	....
1935	1,366.74	364.85	26.7	43.50	3.2	958.39	70.1	....	....
1936	750,87	608.25	81.0	142.62	19.0	....	....	....	....
1937	2,444.42	471.25	19.3	208.62	8.5	1,764.55	72.2	....	....
1938	566.70	341.00	60.2	175.45	30.9	....	....	50.25	8.9
1939	1,510.62	283.50	18.8	171.04	11.3	1,004.58	66.5	51.50	3.4
1940	324.62	160.50	49.4	31.10	9.6	....	....	133.02	41.0
1941	2,515.58	539.90	21.5	182.61	7.2	1,697.46	67.5	95.61	3.8
Average	2,636.04	807.81	30.6	528.87	20.1	1.198.96	45.5	100.40	3.8

*Years 1915-1921 not available.

†Chitterlings, grease, casings, ammonia, and fertilizer.

TABLE 2. Slaughter Charges Per Head for Cattle and Hogs at Baton Rouge and Four Other Municipal Abattoirs, 1939

Place	Slaughter fee charged per head for			
	Cattle		Hogs	
	Dressed weight	Fee	Dressed weight	Fee
	(Pounds)	(Dollars)	(Pounds)	(Dollars)
Baton Rouge	Under 176	1.50	Under 101	1.00
	176-275	2.00	101 and over	1.50
	275 and over	2.50		
Austin[1]	Under 84	0.75[2]	Under 72	0.50[2]
	84-167	1.00	72-89	0.75
	168-279	1.25	90-287	1.00
	280-419	1.50	288 and over	2.00
	420-559	1.75		
	560 and over	2.00		
Beaumont	Under 225	1.00	Under 100	0.60
	225-399	1.75	100-199	1.00
	400 and over	2.00	200 and over	1.25
Paris[1]	Under 168	1.50[3]	All weights	1.50
	168 and over	2.00		
Temple	Under 300	1.50	Under 300	1.50
	300 and over	(½ cents per pound)[4]	300 and over	(½ cents per pound)[4]

[1] Charges changed from live weight to dressed weight using the dressing percentages of 56 per cent for cattle and 72 per cent for hogs.

[2] Customers get discounts of 5% to 20% on quantities from 25 to 100 head on all kinds of livestock.

[3] For quantities of 40 head, or more, 65 cents per head refund on cattle and hogs.

[4] Plus 50 cents inspection fee.

APPENDIX B

City of Baton Rouge—Abattoir Ordinance 1915 (Regulations for construction and operation of plant omitted)

Sanitary Regulations—All abattoirs or slaughter houses in which animals are slaughtered, to be used as food, exhibited for sale or sold for food, in the City of Baton Rouge, shall be operated in accordance with the following provisions:

(a) No animals intended for slaughter shall remain on the premises or premises immediately adjoining or adjacent thereto longer than is necessary for the inspection on foot and the immediate slaughter thereof.

(b) All animals intended to be slaughtered shall be inspected while alive and on foot by the Inspector, in pens specially constructed for that purpose, and which shall be well lighted and all animals so inspected shall be slaughtered promptly thereafter; and no animal shall be slaughtered that is not "passed" by the Inspector.

(c) Every animal slaughtered shall be inspected during the process of slaughtering by the Inspector, who shall use such methods of inspection as may be approved or adopted by the City Commission.

(d) Every portion of any animal slaughtered or intended for food or a food product, shall be inspected by the City Inspector and tagged, marked or stamped by the Inspector, and a record of said inspection with the name of owner, kind of animal and condition, shall be made by said City Inspector, which record of each inspection shall be entered upon the Inspector's daily report, which shall be filed with the City Auditor.

(e) The offal, blood and refuse from slaughtered animals and animals or portions thereof condemned upon dead inspection by the Inspector shall be immediately placed in the reduction plant and destroyed under the direction of said Inspector.

(f) All trucks, traps and other receptacles, all chutes, platforms, racks, tables, etc., and all knives, saws, cleavers, and other tools, and all utensils, machinery and articles used in moving, handling, cutting, chopping or other process shall be thoroughly cleaned before using.

(g) All employees shall be examined by the City Physician of the City of Baton Rouge, and no person affected with tuberculosis or any other communicable disease shall be employed in any of the departments where carcasses are dressed, meat is handled, or meat food products are prepared, and all employees shall be examined once a month or as directed by the Inspector, by the City Physician, who shall report their condition to the Inspector and manager of abattoir or slaughter house.

(h) All employees must be cleanly; street clothes, shoes and boots worn by employees must be changed and other clothes worn while doing their work, and all such clothes, shoes, boots, aprons or other outer clothing worn by employees who handle meat or meat food products shall be of a material that is readily cleansed and made sanitary, and only clean garments shall be worn. Persons who handle meat or meat food products shall be required to keep their hands, including finger nails, clean and pay particular attention to cleanliness of their boots and shoes. The Inspector shall see that the clothing and hands of such employees are clean and sanitary, and they shall be required to change or clean same at any time he may so request.

(i) No employee or other person shall be permitted to expectorate on the floor, but cuspidors of such shape and not readily upset shall be provided for employees in each room, and shall be kept thoroughly clean and sanitary.

(j) Water closets, toilet rooms and dressing rooms shall be required for employees, and such rooms shall be entirely separated from compartments in which carcasses are dressed, or meat or meat food products are stored, placed, handled or prepared. Where same opens into such compartments they must, when it is considered necessary, be provided by properly ventilated vestibules with automatically closing doors. Such closets, etc., shall be conveniently located, sufficient in number, ample in size and fitted with modern lavatory accommodations, including toilet paper, soap, running hot and cold water, towels, etc., and shall be properly lighted, ventilated and kept in sanitary condition. Convenient and sanitary urinals and wash stands shall be provided.

(k) The room in which meat or meat food products are prepared, stored, packed, or otherwise handled shall be free of odors from toilet rooms, catch basins, tank rooms, etc., and shall be kept free from flies or other vermin by screening or other methods.

(l) Butchers who dress or handle diseased carcasses or parts shall cleanse their hands of all grease and then immerse them in a prescribed disinfectant and rinse them in clear water before dressing or handling healthy carcasses. All butchers' implements used in dressing diseased carcasses shall be sterilized either in boiling water or by immersion in a prescribed disinfectant, followed by rinsing in clear water, and facilities for same shall be provided. Diseased carcasses shall be handled by separate sanitary trucks, as instructed by Inspector.

(m) Meat and food products must not be permitted to fall on floors and in event of their having so fallen, they must be condemned or soiled portion removed or condemned.

(n) Carcasses shall not be inflated. Carcasses shall not be dressed with skewers, knives, etc., that have been held in the mouth, spitting on whetstones or steels when sharpening knives is prohibited.

(o) Only good, clean and wholesome water shall be used in the preparation of carcasses, parts of meat or meat food products, etc.

(p) When an animal is condemned by the inspector after being slaughtered, the same shall be immediately rendered in the reduction plant, and notice to that effect given to owner.

(q) Each animal that is slaughtered shall be required to remain in the chill and refrigeration room at least twelve hours before same is delivered to owner, or used for food, or offered for sale as food.

(r) Wagons in which meat or meat food products are delivered shall be so constructed, closed and covered that the contents shall be kept clean.

(s) The manager of all abattoirs and slaughter houses shall notify the Inspector in ample time to enable him to prepare for and make one inspection.

(t) It shall be the duty of the Inspector to see that all the provisions of this section are duly observed.

INSPECTION OF MEAT BROUGHT OR SHIPPED IN—All meat or meat products used for food or sold for food in the City of Baton Rouge, including canned or cured goods from packing houses, abattoirs, or slaughter houses, slaughtered under regulations similar to those contained in this ordinance and not within the Parish of East Baton Rouge, shall be inspected and stamped by the Inspector, unless bearing Federal inspection mark, in which event the Inspector may not make same, and in addition to the regular inspection shall be inspected for chemicals and preservatives when in the judgment of the Inspector it is necessary.

ALL SLAUGHTERING MUST BE AT ABATTOIRS—The provisions of this ordinance in reference to the equipment, management and operation of abattoirs or slaughter houses shall apply to the City Abattoir and all other abattoirs or slaughter houses now constructed or in operation or that may hereafter be constructed or operated and from and after the passage of this ordinance it shall be unlawful for any person, firm, corporation, association, butcher, vendor of meat or any other person to have any animal slaughtered to be used as food, or exhibited for sale as food, or sold for food within the limits of the City of Baton Rouge at any abattoir or slaughter house other than the City Abattoir, or an abattoir or slaughter house equipped, managed and operated in accordance with the provisions of this ordinance, and any such person, firm, corporation, association, butcher, vendor of meat or any other person slaughtering any animal contrary to this provision shall be deemed a misdemeanor, and on conviction of same in the City Court shall be fined in the sum of not exceeding $50.00, or imprisonment not exceeding 20 days, or both at the discretion of the City Judge.

From and after the passage of this ordinance it shall be unlawful for any person, firm, corporation, association, butcher, or any other person to erect, establish, reform, maintain and operate any abattoir or slaughter house where animals are slaughtered to be used as food, or offered for sale or sold for food within the limits of the City of Baton Rouge, which abattoir or slaughter house is not constructed, maintained and operated in accordance with all of the provisions of this ordinance, and any violation of this provision shall be deemed a misdemeanor, and on conviction of same in the City Court shall be punishable by a fine not exceeding $50.00 or imprisonment not exceeding 20 days, or both at the discretion of the City Judge, and each day's violation shall be deemed a separate offense, and punishable as such. From and after the passage of this ordinance it shall be unlawful for any person, firm, corporation, association, vendor of meats or any other person to offer for sale, or sell for use as food within the limits of the City of Baton Rouge any animal or any portion of same which has not been slaughtered at the City Abattoir or at some other abattoir or slaughter house maintained and operated under the provisions of this ordinance or some similar law or ordinance, and any violation of this provision shall be deemed a misdemeanor, and on conviction of the same in the City Court shall be punished by a fine of not exceeding $50.00, or imprisonment not exceeding 20 days, or both at the discretion of the City Judge, and each day's violation shall be deemed a separate offense and punishable as such.

From and after the passage of this ordinance it shall be unlawful for any hotel keeper, restaurant keeper, boarding house keeper, or other person to use as food or offer to sell to others as food any animal or portion of same not inspected by the Inspector and slaughtered at some abattoir or slaughter house maintained and operated under the provisions of this ordinance or some similar law or ordinance and any violation of this provision shall be deemed a misdemeanor and on conviction of same in the City Court punished by a fine of not exceeding $50.00, or imprisonment not exceeding 20 days, or both, at the discretion of the City Judge; from and after the passage of this ordinance any manager, owner or operator of any abattoir, or slaughter house, or any employee of same, or any inspector who shall violate any of the provisions set out in this ordinance as regulating the management and operation of same shall be deemed guilty of a misdemeanor and on conviction of the City Judge of same in the City Court, shall be punished by a fine not exceeding $50.00, or imprisonment not exceeding 20 days, or both, at the discretion of the City Judge. . . . .

The offal and refuse and all products therefrom is to be the property of the City, and the above charges are in addition thereto.

All fees shall be due and payable as soon as the service has been performed.

Be it further ordained, etc., That this ordinance shall take effect from and after its passage, public necessity demanding same.

Signed: Alex Grouchy, *Mayor.*

W. P. Burden, *Secretary.*

REVIEWED IN DEC 7 - 1942

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POTASH INSTITUTE, INC

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J. D.

Fertilizer Results with Tung Trees and Recommended Cultural Methods

By

W. D. KIMBROUGH, JULIAN C. MILLER
AND W. F. WILSON

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
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52246

FERTILIZER RESULTS WITH TUNG TREES AND RECOMMENDED CULTURAL METHODS

W. D. Kimbrough, Julian C. Miller
and W. F. Wilson

INTRODUCTION

There has been a great deal of interest in the production of tung oil in the United States for the past 15 years. Considerably more than 100,000 acres have been planted to tung trees during this period. Tung oil has been produced in China for a long time and the United States has imported most of their supply. The war with first the reduction and then the practical elimination of the supply of tung oil from China has created more interest in the planting of tung trees here.

The high price of tung oil during war time is another incentive to production. How long this condition will continue cannot well be predicted, but it would be best to consider that the war will likely be over before trees that are set out from now on will come into normal bearing. After the war, however, conditions in China may be unsettled for a time. Because of the demand and need for tung oil in industry, it would seem wise to utilize many more acres of suitable land for the growth of tung trees and lessen our dependence on outside sources for oil. The tung oil that has been produced in this country has proved to be superior to the imported product.

Experimental results that are reported in this bulletin deal largely with fertilization. Because of the interest in tung trees, however, general recommendations for their growth based on observations and the results of other workers will be given. There are several species of tung trees but the only one grown in this country commercially is *Aleurites fordi,* Hemsl., that was introduced originally from China in 1905.

LOCATION

The planting of tung trees has been largely restricted to the Gulf Coast States and, with the exception of Florida, to the southern part of these states. This is because the trees may be called semi-hardy and cannot stand severe cold. The condition of the trees when low temperatures occur has much to do with the degree of cold they can withstand. Fully dormant trees in good condition have stood temperatures close to 0° F. without serious injury. The trees do not have a very long rest period and tend to bud out early in the season and then become subject to cold injury. So far the most serious problem with tung trees, inasmuch as cold injury is concerned, has been early blossoming with subsequent killing of blooms. In 1940 an early severe freeze in November came while the trees were in full leaf and did considerable damage, especially to young trees, many of which were killed.

Since 1933 some tung trees have been growing at the substation in north Louisiana at Calhoun. These trees have borne a crop of nuts every year since they were three years old. It may be that colder weather in that area keeps the trees dormant and thus prevents the damage after blossoming that often occurs further south. This planting and others in the same latitude indicate that tung trees may be grown further north than present commercial plantings extend.

Rolling land that has good air and water drainage is better than flat land for the location of tung trees. These trees will not do well unless there is excellent drainage. Low swampy areas should not be planted to tung trees for they will not thrive there. There is much cutover pine land in Louisiana that is suitable only for tung trees or reforestation.

SOIL

A sandy loam soil with a porous clay subsoil seems to be suitable for the growth of tung trees. Soils of the Orangeburg and Ruston series are probably best for these trees but some other types have also been planted. There should be no layer of hardpan near the surface of the soil. The soil should be moderately acid in reaction, with a pH range of 5 to 6.

PREPARATION OF LAND

Land should be cleared before trees are planted. Many groves were formerly planted without the removal of stumps. Later the stumps were pulled in many of these plantings, but clearing land in a grove of tung trees is more expensive and often cannot be done as well as before the trees are set out. Clearing land is a comparatively expensive operation, but the cost can be reduced if stumps can be used in the manufacture of naval stores.

It is not necessary to break all the land before trees are planted, but it is desirable to do so if a cover crop is to be planted. A strip should be plowed at least six feet wide in which to plant the seed or set out the young trees.

PROPAGATION

Practically all tung groves comprising any extensive acreage have been propagated from seed. It is believed now that seed from selected trees should be planted as there is some tendency for tung trees to come true from seed. Seed should be selected from the most desirable trees, which means that the trees must have produced high yields for a number of years, and the oil content of the nuts should be high. This kind of seed is not too easy to obtain as it must come from trees of known performance which usually means they will be in established groves where careful observations, if no actual records, have been made. Seed should be arranged for at harvest time, if possible.

Seed should be planted in February and covered with about three inches of soil. The seed planted should come from the previous season's crop as the seed has a high oil content and does not keep well. The seed may be planted in the place where the trees are to grow, or in a nursery. If they are to be planted in place, about three seeds should be at a place, about one foot apart each way, to insure a good stand. The best tree in the group should be allowed to grow and the others discarded or transplanted. It is probably best to plant seed in a nursery and transplant the seedling after one season's growth. One year after transplanting, the trees are about the same size as one year old seedlings planted in place. When planted in a nursery seeds should be spaced 12 to 18 inches apart in rows three and one-half to four feet wide. Young trees in the nursery should not be fertilized too heavily for the young seedlings might grow so vigorously that they would be undesirable for transplanting. About 800 pounds of 4-8-4 per acre should be sufficient fertilizer for the nursery.

Seedling tung trees vary greatly in vigor, shape, and yield. The lack of uniformity of trees is one of the biggest problems of the tung grower. Tung trees can be budded without great difficulty, but as yet there is not sufficient information on budded trees to warrant budding as a general practice. The patch bud or the shield bud may be used. It is probably best to bud in the late summer or early fall and allow the bud to remain dormant over winter. The seedlings should be budded in nursery rows rather than in place in the grove, because the growth from the bud is not always satisfactory. Only budded trees that have done well in the nursery should be transplanted. At the present time there are no established varieties and there is considerable difference of opinion as to just what type of tung tree is best. Buds have in general been taken from trees selected similarly to those from which selected seed may be saved. When trees produce a heavy crop of nuts, not much suitable bud wood is available. Interest in the planting of budded trees is increasing and more information on this subject should be available in a few years. Groves from budded trees are much more uniform than those of seedling groves and seem very promising.

TRANSPLANTING TREES

Most of the land suitable for tung trees is rolling and on this type of land the trees should be set on the contours. This will prevent the trees from being in straight rows and will interfere with exact planting distances. It will, however, tend to prevent erosion and this is an important factor. In general tung trees have been planted too close together. Just what planting distance is best at present is not too well agreed upon.

Spacing 30 x 30 feet is suggested here. This means 48 trees per acre and when the trees are small a lower per acre yield than if closer spacings were used. When trees become too crowded they will not produce well and with proper care tung trees grow rapidly. Trees could be set closer together and allowed to grow until they begin to crowd, and thus increase the production of the grove in the earlier years, if the trees would then be thinned. One of the most difficult jobs is to thin out bearing trees of any kind and for that reason close planting with later thinning cannot be generally recommended.

Tung trees are not difficult to transplant. One year old trees from the nursery should be used. The trees should be cut back to within six to twelve inches of the ground. This facilitates handling of trees more economically and rapidly. When growth starts only one shoot should be allowed to grow and the others should be rubbed off. Trees should be transplanted in January or February. They should be set as deep as they were in the nursery row. Only trees that have made satisfactory growth should be transplanted.

FERTILIZATION

One of the most important problems in connection with any new crop grown in the South is its fertilizer requirements. This is especially true with a crop grown on cut-over pine land, as is done with tung trees in Louisiana. To obtain information concerning the response of tung trees to fertilizer, experimental plots were laid out in two commercial groves in cooperation with the owners.

One of these experiments was started in the spring of 1933 with one-year old trees from seed planted in place. These plots will be referred to as the Isabel plots and were about 10 miles southwest of Bogalusa. The land had been in cultivation and was cleared prior to the planting of seed. The soil type was Ruston fine sandy loam. The trees were uniform in size and were spaced approximately 20 feet apart each way. There were three replications of 15 trees each for every fertilizer treatment. There were guard rows between tiers of plots but it was impossible to have guard rows between the rows of fertilized trees. The fertilizer treatments given are shown in Table 1. Diameter of trunk six inches from the ground was used as an index of tree growth.

The other experiment was begun in the spring of 1936 with one year old nursery stock that had just been transplanted. These plots were between Covington and Bogalusa, near Bush, and are referred to as the Money Hill plots. The soil type and set-up were similar to the Isabel plots except that 12 trees were used per plot and the trees were set out on the contour approximately 20 by 25 feet apart. The land was not fully cleared, for many stumps were left in the field when the tung trees were transplanted. Most of these stumps were removed later, however. The fertilizer treatments used on these plots are given in Table 3.

TABLE 1. Effect of Fertilizer Treatment on Yield of Tung Trees Grown from Seed Planted in 1932 in Place.

Treatment per tree			Average yield per tree in pounds					
1933	1934	1935 and after	1936	1938	1939	1940	1941	6 yr. ave.
Check—no fertilizer			4.1	6.6	0.8	11.6	3.4	4.4
0.5	0.75	1.0# 4–8–4	7.8	8.7	2.9	16.8	6.4	7.1
1.0	1.5	2.0# 4–8–4	13.7	14.9	4.4	23.7	11.7	11.4
2.0	3.0	4.0# 4–8–4	15.7	19.7	2.5	26.2	11.1	12.5
3.0	4.5	6.0# 4–8–4	17.4	19.7	5.7	30.9	20.9	15.8
4.0	6.0	8.0# 4–8–4	20.0	21.2	4.9	33.5	18.0	16.3
Check—no fertilizer			6.5	7.9	1.7	12.4	4.2	5.5
3.0	4.5	6.0# 4–8–0	19.5	22.1	2.3	21.0	12.9	13.0
3.0	4.5	6.0# 4–0–4	8.4	17.9	1.9	20.2	9.4	9.6
3.0	4.5	6.0# 0–8–4	16.4	13.9	3.8	14.6	9.3	9.7
3.0	4.5	6.0# 4–8–4	18.1	16.5	2.8	20.9	12.0	11.7

The fertilizer treatments were varied so as to try to determine the most economical rate of complete fertilizer to apply and whether a complete fertilizer was necessary. In the Money Hill experiment an attempt was made to determine whether it was necessary to apply a complete fertilizer every year.

The results obtained from the Isabel plots are shown in Tables 1 and 2. The data show that growth and yields were materially influenced by the application of fertilizer. There was a direct positive correlation between the amount of fertilizer applied and increase in growth and yield. The larger percentage increase in nuts per tree was from the smaller rates of fertilizer applied. Phosphorus and nitrogen were found to be especially deficient, but no benefit from potash was found for the duration of the experiment. The phosphorus deficiency was very striking

TABLE 2. Effect of Fertilizer Treatment on Growth of Trees as Determined by Trunk Diameter.

Treatment per tree			Average diameter of tree 6 inches above ground at the end of growing season in inches					
1933	1934	1935 and after	1934	1935	1936	1937	1938	1939
Check—no fertilizer			2.5	3.2	3.6	4.0	4.1	4.6
0.5	0.75	1.0# 4–8–4	2.9	3.5	4.1	4.6	4.7	5.3
1.0	1.5	2.0# 4–8–4	3.1	3.9	4.8	5.4	5.4	6.1
2.0	3.0	4.0# 4–8–4	3.2	4.0	4.8	5.5	5.6	6.2
3.0	4.5	6.0# 4–8–4	3.3	4.2	5.0	5.8	6.0	6.6
4.0	6.0	8.0# 4–8–4	3.4	4.3	5.1	5.9	6.1	6.9
Check—no fertilizer			2.6	3.3	3.9	4.3	4.5	5.0
3.0	4.5	6.0# 4-8-0	3.3	4.2	5.1	5.7	5.9	6.5
3.0	4.5	6.0# 4–0–4	2.8	3.6	4.2	4.9	5.1	5.7
3.0	4.5	6.0# 0–8–4	3.0	3.9	4.8	5.3	5.5	5.9
3.0	4.5	6.0# 4–8–4	3.4	4.2	5.2	5.8	6.0	6.5

at the start of the experiment, while lack of nitrogen was more apparent after the first crop of nuts was produced.

Figures 1 and 2 show the nuts produced in 1936 from the first tier of a check plot and a plot which received one pound of 4-8-4 the first year, one and one-half pounds the second year, and two pounds the third year and thereafter.

The data from the Money Hill plots are given in Tables 3 and 4. These show that a complete fertilizer was necessary for the best growth and the highest yield. Greater increases in growth and yield were obtained from phosphorus and nitrogen than from potassium, but the latter element was definitely beneficial. This test, too, gave increased growth and yield with increased applications of fertilizer, but the results are not as striking as those obtained on the Isabel plots. The trees were younger, though, and larger yields might produce greater differences. While the experiment was conducted for only a short time the results indicate that the application of a complete fertilizer was not necessary every year.

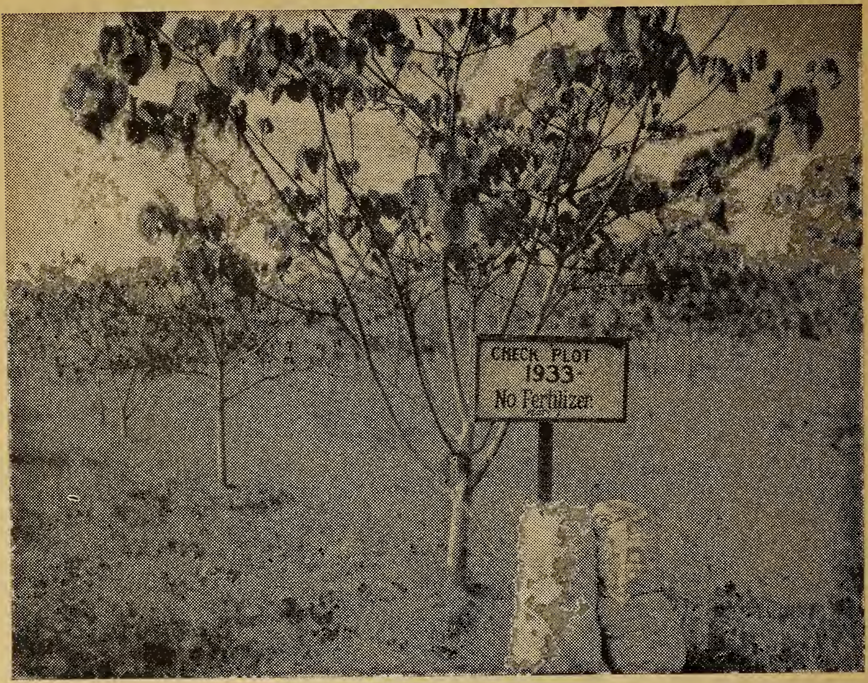

FIGURE 1. Nuts Produced in 1936 from the First Tier of Trees of the Isabel Plots. No Fertilizer Was Used.

These experiments showed that the application of fertilizer was decidedly beneficial to the growth of tung trees and materially increased the yield of nuts. A complete fertilizer is safest to apply especially on new ground that has previously received no fertilizer. Heavy applications of fertilizer were not found to be required. When tung oil is sold for a normal price of from 10 to 15 cents a pound the application recommended per tree is one pound of 4-8-4 the first year, one and one-half pounds the second year, and two pounds the third year and thereafter until the size of the tree and yield will warrant applications up to four pounds per tree. When the price of oil is 25 to 35 cents per pound applications up to six pounds per tree may be profitable. The fertilizer should be applied the last of February to the first half of March. It should be spread around the tree extending a little further out than the spread of the branches and disced into the soil as soon as possible after its application. Only one application of fertilizer is recommended in Louisiana, for if fertilizer were applied in the middle of the summer growth might be stimulated late in the season with cold injury likely to result. No tests were run to determine the advantage of the application of zinc and manganese to tung trees. The application of these elements have been found to be beneficial to some Florida groves and might be of value to some of the Louisiana plantings.

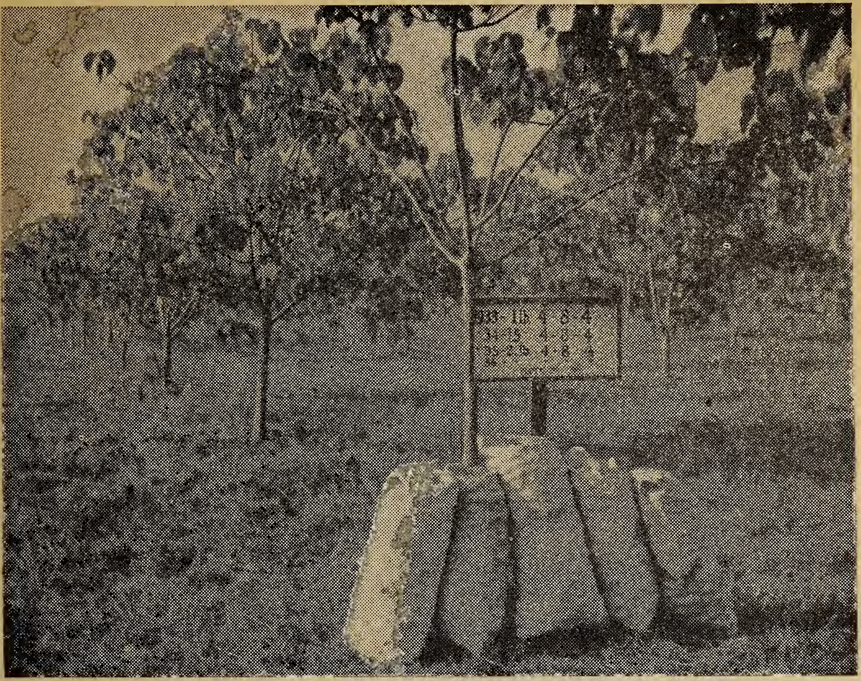

FIGURE 2. Nuts Produced in 1936 from the First Tier of the Isabel Plots. Applications of 4-8-4 Fertilizer Resulted in Heavy Yield of Nuts. For Comparison, See Figure 1.

TABLE 3. Effect of Fertilizer Treatment on Yield of Tung Trees.

Treatment						Average yield per tree in pounds				
1936	1937	1938	1939	1940	1941	1938	1939	1940	1941	4 yr. ave.
Check—no fertilizer						2.2	4.8	8.7	10.4	6.5
1.0	2.0	3.0	4.0	5.0	5.0# 4–8–0	2.6	6.2	12.5	14.0	8.8
1.0	2.0	3.0	4.0	5.0	5.0# 4–0–4	3.0	4.8	8.5	11.7	7.0
1.0	2.0	3.0	4.0	5.0	5.0# 0–8–4	2.0	6.8	7.1	13.9	7.5
1.0	2.0	3.0	4.0	5.0	5.0# 4–8–4	4.0	8.7	15.2	17.6	11.4
Check—no fertilizer						1.1	2.7	5.5	7.4	4.2
0.5	0.5	0.5	0.5	0.5	0.5# 4–8–4	4.1	6.3	9.5	8.8	7.2
0.5	0.75	1.0	1.5	2.0	2.0# 4–8–4	3.3	8.1	11.8	12.6	9.0
1.0	1.0	1.0	1.0	1.0	1.0# 4–8–4	3.6	8.3	10.9	14.3	9.3
1.0	1.5	2.0	2.5	3.0	3.0# 4–8–4	3.7	7.9	11.8	15.4	9.7
Check—no fertilizer						1.3	3.4	7.8	7.0	4.9
1.0	2.0	3.0	4.0	4.0	4.0# 4–8–4	4.8	8.3	15.6	14.1	10.7
1.0	2.0	3.0	4.0	5.0	5.0# 4–8–4	4.6	9.4	15.0	15.4	11.1
2.0	2.0	2.0	2.0	2.0	2.0# 4–8–4	5.7	9.2	16.6	13.9	11.4
2.0	3.0	4.0	5.0	6.0	6.0# 4–8–4	5.3	13.1	18.0	22.2	14.7
2.0	3.0	no more fertilizer				5.6	4.7	12.9	13.5	9.2
2.0	3.0	N*	4.0	N	4.0	5.3	13.7	16.6	24.2	15.0
2.0	3.0	N*	N	4.0	N	4.9	12.2	15.1	25.5	14.4
2.0	3.0	P*	4.0	P	4.0	5.0	10.1	22.5	20.1	14.4
2.0	3.0	K*	4.0	K	4.0	5.0	6.8	16.0	17.9	11.4
2.0	3.0	4.0	4.0	4.0	4.0	5.8	11.0	13.0	21.0	12.7

*Equivalent to the amount in 4# of 4–8–4.

It is possible that fertilizer might not only affect the yield of nuts but also the percentage of kernels in nuts and the percentage of oil in the nuts and the quality of the oil produced. To get some information on these questions the following experiments were run. At harvest time a sample of nuts was selected which contained nuts from each bearing tree in a fertilizer treatment. This sample weighed at least a hundred pounds if the plots produced that many nuts. The samples were stored for several weeks, then run through the huller at the tung oil mill at Bogalusa. For the 1936 crop the huller was set to remove most of the hulls, but for the other years the huller was left as for commercial handling of the nuts and contained a much higher percentage of shells and hulls, especially for the 1938 and 1940 crops. In the extraction of the oil by pressure it is necessary to have a certain amount of hulls ground with the nut meats. A sample of shelled nuts from each fertilizer treatment was taken and from this the oil content was determined by the ether extraction method. The iodine number of the oil was determined by the Wijs method.

The data obtained from the Isabel plots are given in Table 5. The percentages of oil and iodine numbers are given for only two years, as the results for the other years showed no significant differences. The iodine numbers for 1936 are not given, as they were made on oil extracted by press and were slightly higher than those from ether extracted oil.

TABLE 4. EFFECT OF FERTILIZER TREATMENT ON GROWTH OF TREES AT THE MONEY HILL PLANTING.

TREATMENT					AVERAGE DIAMETER OF TREE 6 INCHES FROM GROUND AT THE END OF GROWING SEASON—IN INCHES			
1936	1937	1938	1939	1940	1936	1937	1938	1939
Check—no fertilizer					1.0	2.3	3.0	3.7
1.0	2.0	3.0	4.0	5.0# 4-8-0	1.0	2.4	3.2	3.9
1.0	2.0	3.0	4.0	5.0# 4-0-4	1.2	2.4	3.2	3.8
1.0	2.0	3.0	4.0	5.0# 0-8-4	1.1	2.4	3.3	3.8
1.0	2.0	3.0	4.0	5.0# 4-8-4	1.4	2.8	3.6	4.2
Check—no fertilizer					1.0	2.1	2.8	3.4
0.5	0.5	0.5	0.5	0.5# 4-8-4	1.2	2.5	3.2	3.8
0.5	0.75	1.0	1.5	2.0# 4-8-4	1.3	2.5	3.3	3.9
1.0	1.0	1.0	1.0	1.0# 4-8-4	1.4	2.5	3.4	4.1
1.0	1.5	2.0	2.5	3.0# 4-8-4	1.5	2.6	3.5	4.2
Check—no fertilizer					1.0	2.0	2.8	3.3
1.0	2.0	3.0	4.0	4.0# 4-8-4	1.3	2.6	3.6	4.3
1.0	2.0	3.0	4.0	5.0# 4-8-4	1.4	2.6	3.6	4.3
2.0	2.0	2.0	2.0	2.0# 4-8-4	1.5	2.9	3.6	4.3
2.0	3.0	4.0	5.0	6.0# 4-8-4	1.5	2.9	3.9	4.6
2.0	3.0	no more fertilizer			1.5	2.8	3.5	4.3
2.0	3.0	N*	4.0	N	1.5	2.9	3.7	4.6
2.0	3.0	N*	N	4.0	1.5	2.9	3.9	4.7
2.0	3.0	P*	4.0	P	1.5	2.9	3.7	4.7
2.0	3.0	K*	4.0	K	1.5	2.9	3.7	4.5
2.0	3.0	4.0	4.0	4.0	1.5	2.9	3.9	4.8

*Equivalent to the amount in 4# of 4-8-4.

The data show that for the 1936 crop the fertilizer applications influenced the percentage of hulled nuts. Differences seemed mainly due to unfilled kernels. This was true for the first check plots though no record was obtained on them because they were the first experimental nuts run through the huller and some were lost due to a misunderstanding of the men running the mill. No consistent differences from fertilizer treatment were found in the other years. It should be remembered that there were no guard rows between the rows of fertilized trees. It is likely that the filling of nuts is influenced by fertilizer treatment but may not be appreciable except in case of great deficiency of needed fertilizer. Faulty nuts, much worse than any found on the experimental plots, have been noted in unfertilized groves. This may be an important consideration from the standpoint of the oil mill.

No consistent significant differences have been found in the oil content of nuts or the quality of the oil, as indicated by the iodine number, due to the fertilizer treatment given the trees. It is known that the oil content in nuts from different seedling trees may vary considerably. The trees in these experiments and in practically all the groves in production at the present time are seedling trees and differences due to fertilizer

TABLE 5. EFFECT OF FERTILIZER TREATMENT ON PER CENT OF HULLED NUTS, OIL CONTENT IN SHELLED NUTS AND IODINE NUMBER OF THE OIL.

FERTILIZER TREATMENT			MILL RUN HULLED NUTS PER CENT				OIL CONTENTS OF SHELLED NUTS PER CENT		IODINE CONTENT —NUMBER OF OIL	
1933	1934	1935&after	1936	1938	1940	1941	1936	1938	1938	1940
Check—no fertilizer			....	46.5	45.9	38.7	59.4	62.5	165.4	166.7
0.5	0.75	1.0#4–8–4	33.0	45.9	47.3	38.4	61.2	65.0	166.1	173.1
1.0	1.50	2.0#4–8–4	37.0	46.2	46.5	39.0	61.2	65.1	164.5	169.9
2.0	3.0	4.0#4–8–4	37.0	45.5	46.8	41.5	60.1	62.9	166.9	169.9
3.0	4.50	6.0#4–8–4	37.0	47.7	48.3	41.3	58.4	65.5	166.9	168.2
4.0	6.00	8.0#4–8–4	37.0	46.3	49.4	39.1	61.0	63.5	166.9	163.4
Check—no fertilizer			30.0	45.7	43.9	35.6	59.4	63.7	166.9	168.2
3.0	4.50	6.0#4–8–0	37.5	45.4	48.9	41.1	61.4	62.9	170.1	168.2
3.0	4.50	6.0#4–0–4	31.0	45.0	45.9	38.3	59.7	63.8	168.5	168.2
3.0	4.50	6.0#0–8–4	36.5	45.3	46.7	37.0	65.0	65.1	171.3	165.0
3.0	4.50	6.0#4–8–4	37.0	46.3	47.8	40.6	62.2	64.5	172.9	166.6

treatments may be overshadowed by individual tree differences. Differences from fertilizer treatments might be found in nuts in a grove of budded trees of one kind. The results obtained indicate that the oil content or quality of oil in well filled nuts from a seedling grove is not affected by fertilizer treatment.

CULTIVATION

Tung trees must be well cared for if good crops are to be expected from them. The trees must be cultivated. On large plantings this may be done with large discs pulled by tractors. When the trees are young, strip cultivation may be practiced. Two to three cultivations a year are necessary. Cover crops properly handled are beneficial to tung groves. Crotalaria is a very good cover crop for young non-bearing groves. A winter cover crop such as Austrian peas or vetch is probably most satisfactory for tung groves. In general the soils on which tung trees are planted is deficient in phosphorus and a phosphatic fertilizer should be applied to the cover crop for good growth. Two to three hundred pounds of 18 per cent superphosphate per acre should be sufficient. No cover crop that has made much growth should be in the grove at the time the nuts are harvested.

HARVESTING

When fully mature, tung nuts drop from the trees and are picked up when they are dry. There is some variation in the time of maturity of nuts on individual trees in a grove, but the nuts on most of the trees will tend to mature at about the same time. The harvesting is very simple and can be done with almost any kind of labor. The laborers are usually paid for the amount of nuts gathered. There should be no grass, weeds, or other vegetation around the trees at harvest time that may hinder the picking up of nuts or may prevent the nuts from being found.

STORAGE

After harvest the nuts should be stored in a dry, well ventilated place. Storage space should be provided for in advance of the harvest season. If the nuts are not thoroughly dry when put in storage, some heating may occur. Care should be taken to prevent heating, if possible. Nuts are harvested usually in November and December and the oil mills are started about February. During storage the nuts may shrink from 10 to 15 per cent which is due primarily to further drying. The nuts should be milled as soon as possible to prevent them from becoming rancid when warm weather comes.

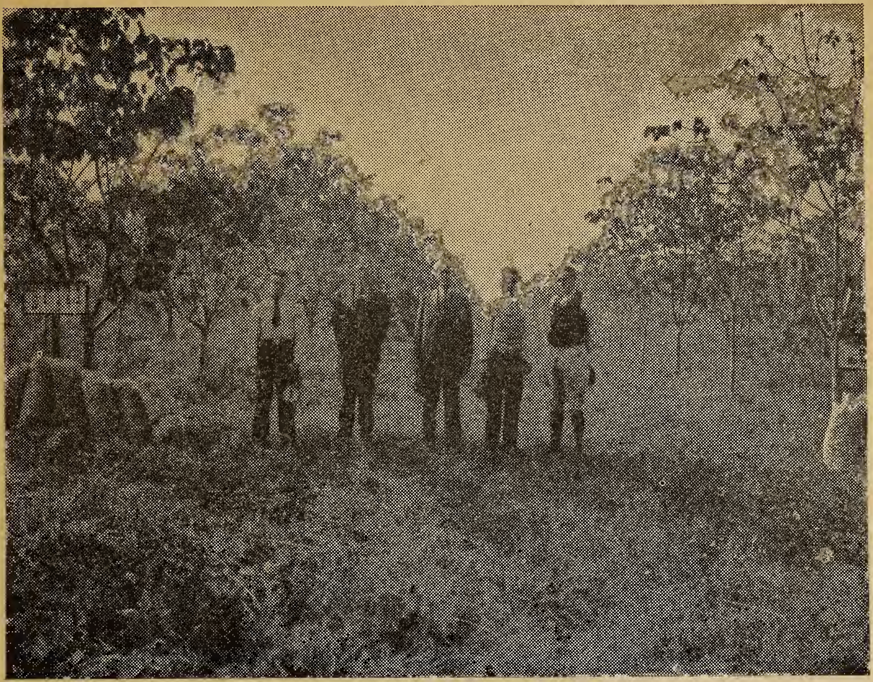

FIGURE 3. Experiment Station Research Workers and Others Are Shown in Tung Grove. Note the Difference in the Fertilized (Left) and Unfertilized Trees.

YIELDS

Commercial tung oil production is a relatively new industry in the United States and much desirable information concerning the production of tung nuts is still unavailable. Information concerning probable yields of groves over a period of years is still largely an estimate. Variations in yields may be due to a number of factors. The six year average yield on the Isabel plots reported in this paper show the highest average yield per tree was about 16 pounds of nuts. During this period there was no crop for one year and a very light crop for another. The trees would have borne a year earlier except for a late freeze. There was no indication of a steady increase of yield of nuts per year as the trees grew older. The results from Money Hill were similar. Environmental conditions influence yield as well as age of tree. The number of trees per acre will also influence yield until the space in the grove is about fully utilized. Wide spacing will reduce yields of young groves and close spacing, because of crowding, will reduce yields in the older groves.

Individual trees vary greatly in yield under similar conditions. Two trees of approximately the same size may vary greatly in yield. Certain types of trees bear heavily when they are young, and of course heavy production tends to reduce size. Cluster types in general tend to produce more nuts than single types but this is not always true. To give an idea of the variability of individual tung trees in a grove, some of the yields of trees in the fertilizer plots are given in Table 6. If uniformly high producing trees were found in a grove, the per acre yield of the grove would be greatly increased. From the yields obtained in the fertilizer plots it would seem that average yields of bearing trees might be expected to be from about 700 to 1500 pounds of nuts per acre in well cared for seedling groves. Yields might be considerably higher in groves of high producing budded trees, or in those that received special

TABLE 6. INDIVIDUAL VARIATION IN YIELD OF SELECTED GROUPS OF TUNG TREES, EACH TREE IN A GROUP RECEIVED THE SAME TREATMENT.

TRUNK DIAMETER 6 INCHES ABOVE GROUND	AVERAGE YIELD OF NUTS IN POUNDS PER TREE				
1939	1938	1939	1940	1941	4 yr. ave.
4.4	0.0	6.4	0.7	0.8	3.1
4.3	4.7	12.0	15.5	15.8	12.0
4.6	6.0	5.7	22.3	21.0	13.7
4.6	9.3	12.3	20.6	21.5	15.9
5.9	0.0	1.0	0.0	1.2	0.6
5.1	7.2	14.4	12.2	18.5	13.1
5.5	6.7	19.2	21.3	20.0	16.8
4.5	9.7	22.7	20.6	41.7	23.7
4.8	1.7	8.4	3.2	1.5	3.7
5.0	3.0	5.0	4.2	3.2	3.9
5.1	10.0	11.5	19.5	24.2	16.3
4.4	9.5	9.8	22.3	27.5	17.3
4.6	14.0	1.0	46.0	7.2	17.1
4.9	5.0	7.4	4.5	6.7	5.9
4.8	8.5	4.2	17.0	18.2	12.0
4.8	12.7	1.6	29.3	22.7	16.6
4.8	1.7	12.6	18.0	31.0	15.8

care and heavy fertilization, than in the average seedling grove. In neglected groves yields are likely to be very low.

A few nuts may be produced the third year the trees are in the grove but extensive crops should not be expected before the fourth or fifth year.

ECONOMICS OF PRODUCTION

There is little reliable information concerning the profit from commercial tung groves. Small high producing groves cannot be used to show what a larger grove may do. Yields in a good bearing year, while important, do not mean nearly as much as the average yearly production over a period of several years. A non-bearing year may not be a total loss, for more growth may be made and thus mean potentially larger yields in following years. Until the imports of tung oil from China were cut off the net returns per acre that might be expected from tung trees was not large. As long as high prices continue better returns will be obtained from the groves.

The thoroughly dried tung nuts will average about 20 per cent oil. The mill should extract about 95 per cent of the oil. This means that about 380 pounds of oil should be obtained from a ton of nuts. At 15 cents a pound, this would be worth $57, and at 35 cents a pound, $133. When the oil was worth 15 cents a pound the mills paid about $30 a ton for the nuts and when the oil was worth about 30 to 35 cents a pound the mills paid $80 a ton, delivered at the mill. This means that more profit can likely be made when an organization can mill the nuts produced rather than sell to a mill. However, it should be remembered that the mill is idle most of the year.

High priced land is still not recommended for tung trees. Large groves can be handled more economically than small ones and are more likely to succeed. A few acres of tung trees as a part of a diversified farm program may be profitable, if the farm is relatively close to a mill. Nearness to a mill is an important consideration in tung oil production, for the cost of hauling nuts to the mill must be taken into account. Several mills have started operations in the last few years. Whether more mills can be built before the war is over is a question. There is no use in having nuts, except which may be sold for seed, unless they can be milled. The nuts do not keep for an extended period of time and should be milled before the summer following their production. It is not known what the productive life of a tung tree may be in this country. Trees will have to be grown under favorable conditions for a number of years to get an idea of how long they will live. With proper care groves on good soil may be reasonably expected to last for 20 years or more.

To date, the by-products from tung oil manufacture do not amount to much. The hulls have little value as fertilizer, though they are often returned to the grove. This would be more easily accomplished if nuts could be hulled at or near the grove. This may be possible only when portable hullers are available. The ground press cake, made after the oil has been pressed out, is returned to the trees as fertilizer. Its analysis is about 2.5 to 3.5 per cent nitrogen, .70 per cent phosphoric acid, and .12 per cent potash.

PESTS AND OTHER SOURCES OF INJURY

Insects and diseases are still not serious pests in tung groves. Several diseases have been found, however, and will likely become more important in the future. The leaves seem to be poisonous to most leaf eating insects and so they are not generally injurious. The nuts are a violent purgative and this prevents them from being eaten by humans when this fact is known.

Wind does considerable damage to tung trees, especially those that are poorly shaped.

FEDERAL WORK WITH TUNG TREES

Since 1938 the United States Department of Agriculture has been conducting extensive work with tung trees and nuts. Much valuable information is being obtained. Dr. G. F. Potter is directly in charge of this work and he is located at the United States Tung Laboratory, Bogalusa, Louisiana.

Acknowledgments

The writers wish to express their appreciation to the Bogalusa Tung Oil Company, and the Gaylord Container Corporation for their cooperation and interest in the fertilizer work. They also wish to thank Mr. C. C. Moreland and Mr. W. P. Denson of the State Fertilizer and Feed Stuffs Laboratory for determining the oil content of the tung nuts and iodine number of the oil.

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Farmer Experience with the Beef Cattle Enterprise in Louisiana

By

FRANK MERRICK AND J. NORMAN EFFERSON

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FARMER EXPERIENCE WITH THE BEEF CATTLE ENTERPRISE IN LOUISIANA

FRANK MERRICK AND J. NORMAN EFFERSON*

The beef cattle industry in Louisiana has developed rapidly in recent years. Successful tick eradication and higher prices for meat animals have encouraged an increase in cattle numbers on farms. With a reduction in cotton acreage, many Louisiana farmers have been faced with the problem of finding new ways for profitable utilization of their land, labor, and equipment. Beef cattle production is one way of meeting this need.

This more favorable opportunity has caused many farmers to seek facts about the beef cattle industry in the State and its possibilities for future development. In an attempt to provide such material and to have facts from farmer experience, the Louisiana Agricultural Experiment Station studied the beef cattle enterprise on 197 farms in five important areas of the state for the year ending with August, 1940. On most of these farms, beef cattle, although not the most important enterprise, contributed a substantial part of total farm returns.

The purposes of this report are: (1) To present a description of and variation in the important items of cost and return on farms producing beef cattle. (2) To point out standards of efficiency in production and management practices by which the individual beef cattle producer may judge the effectiveness of his own methods. Facts concerning the size of the herd, the calving percentage, the amount of home-grown feed produced, the amount of man labor required to maintain the enterprise, and similar data, when compared to average rates of accomplishments help the farmer to determine the strong and weak points of his business. (3) To present an analysis of the factors affecting efficiency and, in turn, the returns from beef production. Many important factors influencing costs and returns are subject to change under human control. It is those physical and economic factors which the operator may influence by his management that are analyzed in an attempt to show why some farmers are more successful than others in the production of beef cattle.

METHODS AND SCOPE OF THE STUDY

Detailed records were obtained in each area, by interview, in the fall of 1940, covering the one-year period just ended. The areas of study were as follows: Area 1, East Louisiana General Farming, in East and West Feliciana Parishes; area 2, Central Louisiana Mixed Farming, in Pointe

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Coupee, St. Landry, and Rapides Parishes: area 3, Mississippi Delta Cotton Farming, in Tensas, Madison, and Richland Parishes; area 4, Rice Farming, in Jefferson Davis, Calcasieu, Acadia, and Lafayette Parishes; and area 5, Southwest Louisiana Cut-over Pine Area, in Vernon, Beauregard, and Allen Parishes. (Figure 1). These will be referred to hereafter as Eastern, Central, Delta, Rice, and Cut-over Areas.

The farms studied were limited to those having at least 20 head of breeding stock per farm. A trained enumerator visited each farm and recorded careful estimates of the previous year's business as obtained from the farmer's records, the records of feed dealers and cattle buyers, and the farmer's memory.

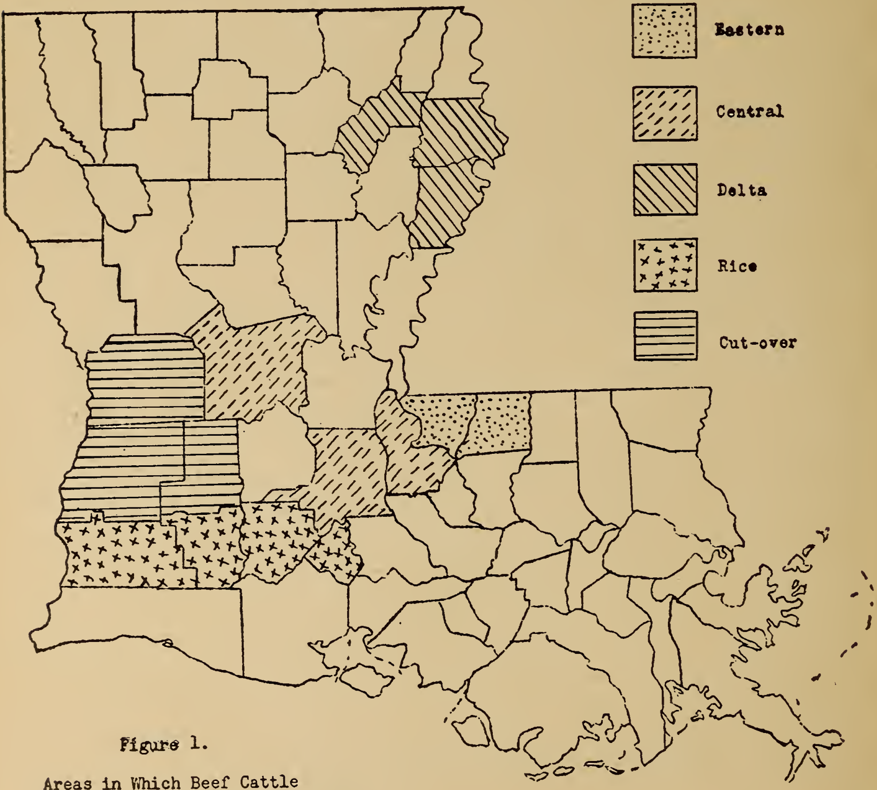

Figure 1.

Areas in Which Beef Cattle Producers Were Interviewed, 1940.

AVERAGE COSTS OF AND RETURNS FROM THE BEEF CATTLE ENTERPRISE IN LOUISIANA

The costs of and returns from the beef cattle enterprise on 197 farms in Louisiana are shown in Table 1. For the 1940 calving season, there were 98 cows per farm, which *raised* 57 calves per farm, or 58 calves per 100 cows. The calving percentage, or the total number of calves *born* per 100 cows was 62.

In this analysis of the costs of producing beef cattle, all expenses used entirely on the beef cattle enterprise were charged directly to the enterprise, and the costs jointly affecting beef cattle and other farm enterprises were distributed according to the farmer's estimate of the proportion of use for each enterprise. The expenses were divided into the current "operating costs," which were mostly cash costs, and the non-cash "overhead costs."

Operating Costs

The current operating or "out-of-pocket" costs for maintaning the beef cattle enterprise were $724 per farm, or $5.25 per head of grown stock, i.e., all cattle more than one year of age. In addition to these costs of operating the enterprise, a cash expense of $295 per farm was incurred to purchase cattle as replacements for stock sold, to increase the breeding herd, and to buy herd bulls.

Home-grown feed for the beef cattle enterprise was the largest item of cost, 27 per cent of the operating expenses. These feeds were charged to the enterprise at the estimated cost of producing them on the farm.[1] Purchased feeds accounted for 22 per cent of the charges. Feeds made up one-half of the total operating costs. Due to the unusually severe winter of 1939-40, the feed requirements were much higher; and the cost per unit of feed was relatively high, due to shortages in certain localities.

The charge for man labor averaged $107 per farm, or 15 per cent of the total. This included the cash cost of all labor hired for the enterprise, and also the labor of the operator and members of his family, charged at the rate per hour that could have been earned by this labor at other farm work or at hire off the farm. Other operating costs included horse work, land rent, pasture maintenance and improvements, fence maintenance, transportation, marketing commissions, water system costs, and various other small miscellaneous expenses.

Overhead Costs

The overhead, or indirect non-cash costs, for the beef cattle enterprise averaged $722 per farm, or $5.24 per head of grown stock. Of this total, 51 per cent was the farmer's estimated rental for land; 37 per cent was interest on the investment in beef cattle; and the remainder was interest and depreciation on the water system, buildings, and fences.

Since farmers in this study usually owned the land, cattle, and equipment, they did not actually pay rent or interest for their use. However, in order to place all producers on a similar basis, charges have been made for investment in all items, whether or not actually owned. The interest rate of five per cent represents what they probably would have had to pay for funds if borrowed and is, in general, the rate of return they could expect for their money if loaned to another for similar use.

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[1] Includes all cash cost of production and charges for land, interest, and depreciation on machinery and equipment used.

TABLE 1. Costs of and Returns from the Beef Cattle Enterprise, 197 Farms in Selected Areas in Louisiana, September, 1939, to September, 1940.

Item	Costs and returns per farm						Costs and returns per head					
	Eastern	Central	Delta	Rice	Cut-over	All areas	Eastern	Central	Delta	Rice	Cut-over	All areas
	$	$	$	$	$	$	$	$	$	$	$	$
Operating Costs:												
Home grown feed	188	297	297	68	82	195	1.17	1.91	2.00	.44	1.00	1.42
Purchased feed	111	221	121	254	105	162	.69	1.42	.82	1.66	1.27	1.17
Man labor	99	140	127	97	64	107	.62	.90	.86	.63	.78	.78
Horse work	36	41	34	25	19	31	.22	.27	.23	.16	.23	.22
Pasture upkeep and improvement	58	74	40	13	1	37	.36	.48	.27	.08	.02	.27
Prod. of grazing crops	0	27	26	11	5	15	.00	.17	.18	.07	.06	.11
Truck and auto costs	51	40	43	38	8	35	.32	.26	.29	.25	.10	.25
Hired hauling	31	8	16	*	3	11	.19	.05	.11	†	.04	.08
Commission, yardage, and insurance	21	43	14	32	2	22	.13	.27	.10	.21	.03	.16
Fence upkeep	30	32	38	59	2	31	.19	.21	.26	.38	.02	.22
Water system operation	1	11	6	9	*	5	.01	.07	.04	.06	†	.04
Land rent	14	67	29	28	4	30	.09	.43	.19	.18	.04	.22
Miscellaneous expenses	33	55	65	35	17	43	.21	.36	.44	.23	.21	.31
TOTAL OPERATING COSTS	673	1056	856	669	312	724	4.20	6.80	5.79	4.35	3.80	5.25
Purchases	460	458	254	256	93	295	2.87	2.95	1.71	1.67	1.12	2.14
TOTAL CURRENT COSTS	1133	1514	1110	925	405	1019	7.07	9.75	7.50	6.02	4.92	7.39
Returns:												
Sales	1526	1532	1485	1251	490	1240	9.52	9.87	10.02	8.15	5.93	9.00
Inventory increase	411	631	226	334	123	342	2.57	4.06	1.52	2.18	1.49	2.48
Miscellaneous income	24	28	2	16	*	13	.15	.18	.01	.10	†	.09
TOTAL RETURNS	1961	2191	1713	1601	613	1595	12.24	14.11	11.55	10.43	7.42	11.57
Net operating returns	828	677	603	676	208	576	5.17	4.36	4.05	4.41	2.50	4.18
Overhead costs:												
Land use	429	538	522	342	5	367	2.68	3.47	3.52	2.23	.06	2.66
Interest on investment in cattle	295	334	299	317	119	269	1.84	2.15	2.02	2.07	1.44	1.96
Int. and depreciation on water system	1	11	8	1	*	5	†	.07	.06	.01	†	.04
Int. and depreciation on fences	72	62	73	88	9	59	.45	.40	.49	.57	.11	.42
Use of buildings	35	26	20	19	15	22	.22	.17	.13	.12	.18	.16
TOTAL OVERHEAD COSTS	832	971	922	767	148	722	5.19	6.26	6.26	5.00	1.79	5.24

*Less than 50 cents.

The beef cattle enterprise was usually a means of utilizing land, buildings, and equipment which might otherwise have been idle. As such, these items of overhead cost would be of little interest to producers. A return of even one per cent would mean a net gain of that amount over what might have been obtained if the resources had not been used. If, however, additional land had to be purchased and fences and buildings constructed especially for the enterprise, these overhead costs would require direct cash outlays and would have a more direct effect on whether or not a farmer should go into the cattle business or enlarge existing business.

Gross Returns

The gross return per farm averaged $1,595, or $11.57 per head of grown stock. Sales of cattle and calves during the year accounted for 78 per cent, and the inventory increase in stock on hand made up 22 per cent of the total.

For a given year, the increase in the value of the beef herd during a year's operations may result from an increase in numbers, by births and purchases, and an increase in the value per head, due to growth of young stock and/or culling out of low quality stock. It is a source of income because this increased value could be realized if the herd were sold. Over a longer period, however, these increases or decreases appear mostly as "book gains or losses" and not as amounts actually realized. This is especially true in areas or on individual farms where a relatively constant number of cattle is maintained in the breeding herd. The operator depends on the calf crop for the cash income from the enterprise and produces only enough adult stock for replacements. Care must be used in interpreting the gross return figures, in which 22 per cent was due to inventory increases.

The fertilizer value of the manure produced was not included as a part of the non-cash income from beef cattle. The beef herds on the farms studied were on pasture throughout the year and no manure was collected and applied to field crops; thus, no credit was given to the enterprise for manure produced. It is true that the fertility of the pastures was maintained or increased because of the beef cattle; but if the enterprise is given credit for the increased productivity of the pastures due to manure, then it must also be charged with this same credit as an additional cost of pasture. Because of the difficulty of obtaining accurate values of manure on pastures and the fact that any credit given would have to be offset by the same amount as a cost, this item was omitted from both costs and returns.

Net Operating Returns

The net operating returns, i.e., gross returns less operating costs, were $576 per farm, or $4.18 per head of grown cattle. This represented the return for management, and investment in land, livestock, buildings, and equipment. Also, the farm operator obtained an amount equal to the sum charged as a cost for his own and any other unpaid family labor, but would have to pay out of this total interest on borrowed investment funds.

Net operating returns less overhead costs resulted in a net loss of $146 per farm, or $1.06 per head of grown stock. This means that producers failed to get sufficient earnings to cover all allowances for costs, including interest at the rate of five per cent on capital used by the enterprise. Probably, most farmers did not expect a full return of five per cent on capital, a part of which otherwise would have been idle. Thus, net loss as used here shows an accurate result from the accounting standpoint, but it does not fully reflect farmers' action in making the best "opportunity" use of the resources which are available.

COSTS AND RETURNS IN DIFFERENT AREAS

Wide variations occurred in costs, returns, and farm practices in beef production in different type-of-farming areas. The number of grown stock per farm was highest in the Eastern Louisiana area, 160 head, and lowest in the Cut-over area, with 83. The other areas varied from 148 to 155 head. (Table 2). The average value per head of grown stock was $27 in the Cut-over area, and ranged from $32 to $35 elsewhere. The average calving percentage was 62, and varied from 69 per cent in the Central area to around 60 per cent in the other four.

TABLE 2. VARIATIONS IN THE BEEF CATTLE ENTERPRISE IN DIFFERENT AREAS ON 197 FARMS IN LOUISIANA, 1939-1940.

	AREA					ALL AREAS
	Eastern	Central	Delta	Rice	Cut-over	
Number of grown cattle per farm	160	155	148	153	83	138
Value per head of grown stock, dollars	32	33	35	34	27	32
Per cent of herd that died during year	7	9	6	6	8	7
Calving percentage (calves born)	60	69	60	58	59	62
Sales in per cent of inventory value	24	23	23	19	20	22
Rental value per acre of pasture land, dollars	.56	1.09	.49	.67	.08	.64
Pasture cost per head, dollars	2.54	4.15	3.83	2.41	.10	2.94
Hours of man labor per head	6	9	8	5	8	7
Per cent of total feed purchased	37	45	29	79	56	46
Home-grown feed cost per head, dollars	1.17	1.92	2.00	.44	1.00	1.42
Purchased feed cost per head, dollars	.69	1.59	.82	1.66	1.27	1.22
Total feed cost per head, dollars	1.86	3.51	2.82	2.10	2.27	2.64
Acres in cropland per farm	285	443	803	642	39	448

The most intensive management practices were maintained in the Delta and the Central areas. In these areas, pasture costs per cow were relatively high; more improved pastures were used for beef cattle; larger amounts of feed were fed per cow; and more labor was used in caring for the beef cattle herd. The least intensive practices were maintained in the Cut-over area. Here, few improved pastures were used for beef cattle; most of the cattle were grazed on the open range throughout the year, at no cost to the operator for pasture; and very little feed was produced on the farm.

Operating Costs in Different Areas

Operating costs varied from a high of $6.80 per head of grown stock in Central Louisiana, to a low of $3.80 per head in the Cut-over area. These costs per cow were relatively high in the Eastern, Central, and Delta areas, because of heavy expenses for home-grown feed, purchased feed, pasture, and man labor. In the Rice and the Cut-over areas, the beef cattle enterprise was less intensive and smaller amounts of feed and labor were used per cow and less improved pasture maintained. This resulted in relatively low total costs per cow.

Home-grown Feed Costs in Different Areas. The charge for feed produced on the farm and fed to beef cattle varied from about $2.00 per head of grown stock in Central Louisiana and in the Delta, to less than $0.50 per head in the Rice area. Where cotton has been most dominant in recent years, apparently more land has been shifted to feed crops for the beef cattle enterprise. Also, these areas have more fertile soils and obtain higher yields. The Cut-over, Rice, and Eastern areas had relatively low charges for home-grown feed. These farmers did not purchase larger amounts of feed, but simply fed less per cow.

The two most important crops produced on the farm and fed to beef cattle were corn and hay. About one-half of the farmers in the study produced corn, and about two-thirds produced hay for beef cattle feed during the winter of 1939-40. These two crops made up 80 per cent of the total charges for home-grown feeds. Corn was valued at $0.54 per bushel; and hay, at $3.50 per ton. Relatively small amounts of each were used, since the usual practice was to leave the beef cattle herd on pasture throughout the year and put out feed only during short periods in the winter when the weather was severe. In many cases, feed was used only for the animals which appeared to be very weak and in danger of dying before the spring pasture season.

Purchased Feed Costs in Different Areas. Cottonseed meal and cottonseed cake were the two most important concentrates purchased. The main roughages bought for beef cattle were cottonseed hulls and hay. (Table 3).

Cottonseed meal was fed alone or mixed with cottonseed hulls. More than one-half of the producers bought cottonseed meal for the enterprise during the winter season, paying an average price of $1.26 per hundred pounds. On these farms, about 50 pounds of meal were fed per mature cow. Other producers purchased cottonseed cake, at $1.39 per hundred pounds,[2] corn at $0.58 per bushel, and molasses, at 12.4 cents per gallon. Relatively small amounts of each were used.

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[2] Cottonseed cake was slightly higher than cottonseed meal, as some of the producers used the cake pellets.

TABLE 3. AMOUNTS, KINDS, AND COSTS OF PURCHASED FEED FED TO BEEF CATTLE ON 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

	Number of farms using the feed	Average cost per hundred pounds	Cwt. used per farm feeding	Pounds of feed fed per head	Cost per head on farms feeding	Proportion of total feed costs
	Number	*Dollars*	*Cwt.*	*Pounds*	*Dollars*	*Per cent*
Concentrate feeds:						
Cottonseed meal	105	1.26	68	49	.62	52.7
Cottonseed cake	25	1.39	105	60	.83	21.4
Corn	20	.80	126	79	.64	11.8
Molasses	9	1.06	30	20	.21	1.7
All other concentrates	33	.90	72	57	.52	12.4
TOTAL OR AVERAGE	...	.87	...	...	.56	100.0
Roughage and succulent feeds:						
Cottonseed hulls	58	.51	175	115	.59	52.0
Hay	42	.50	209	191	.95	43.7
Silage	1	.50	50	42	.21	.2
All other roughage	11	.23	164	181	.41	4.1
TOTAL OR AVERAGE	...	.44	...	...	.54	100.0

The two important roughage feeds, cottonseed hulls and hay, were purchased for an average price of $10.00 per ton, or $0.50 per hundred pounds. On farms using these feeds, less than 200 pounds was fed per cow during the year.

Man Labor and Horse Work Costs in Different Areas. The man labor cost for beef cattle production was $107 per farm, or $0.78 per head of grown stock. An average of 983 hours of man labor was used per farm, or about seven hours per head of grown stock. The average rate for labor on the beef cattle enterprise was 11 cents per hour.

Man labor requirements in the different areas varied from about eight hours per head, at a cost of about $0.90, in Central Louisiana and in the Delta, to from five to six hours per head in the Rice and the Eastern areas, at a cost of about $0.60 per head. (Table 4). The Cutover area, although having the most extensive type of beef cattle enterprise, had relatively high labor costs because of the necessity for more labor to care for the herd under open range conditions.

Horse work costs for beef cattle amounted to $31 per farm, or $0.22 per head of grown stock. An average of 673 hours of horse work per farm, or about five hours per head of grown stock, was used on the farms in this study. Horse work, which amounted to about two-thirds of the total man labor time, was used in riding the pastures and open range to make occasional observations as to the location and condition of the herd, to drive the cattle from one pasture to another, and to haul feed for weakened and unthrifty animals. The average cost of horse work was $0.05 per hour. This included charges for feed, labor, pasture, depreciation, and interest, and was relatively low in comparison

TABLE 4. AMOUNTS AND COSTS OF MAN LABOR AND HORSE WORK FOR THE BEEF CATTLE ENTERPRISE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

AREA	AVERAGE PER FARM		AVERAGE PER HEAD	
	Amount	Cost	Amount	Cost
	Hours	*Dollars*	*Hours*	*Dollars*
Man labor:				
Eastern	959	99	6.0	.62
Central	1,325	140	8.5	.90
Delta	1,183	127	8.0	.86
Rice	703	97	4.6	.63
Cut-over	640	64	7.7	.78
ALL AREAS	983	107	7.1	.78
Horse work:				
Eastern	595	36	3.7	.22
Central	909	41	5.9	.27
Delta	839	34	5.7	.23
Rice	549	25	3.6	.16
Cut-over	396	19	4.8	.23
ALL AREAS	673	31	4.9	.22

to workstock costs in other areas because of the type of horse used, the fact that these horses were kept for breeding purposes as well as for use on the farm, and that much use was made of the horses on other farm enterprises.

The use of horses in the different areas varied from about six hours per head in Central Louisiana and the Delta, to less than four hours per head in the Rice and the Eastern areas.

Overhead Costs in Different Areas

Overhead costs varied from $6.26 per head of grown stock in Central Louisiana, to $1.79 per head in the Cut-over area. The much lower cost in the latter area was due to the lower charges for land. In this area, most of the land used for pasture was open range used by ranchers without a charge for interest and taxes. In the other areas, most of the land used for pasture was owned or rented by individual producers, and relatively high interest and tax costs were incurred.

Gross Returns in Different Areas

Gross returns from the sales of cattle and calves, the increase in the inventory value of the stock on hand, and miscellaneous items, such as pasture conservation payments, varied from $2,191 per farm, or $14.11 per head of grown stock, in the Central area, to $613 per farm, or $7.42 per head, in the Cut-over area. Much lower returns were obtained in the latter area because of less intensive management practices and lower quality of cattle.

Returns from Sales of Calves. The usual management practice on most farms in all areas was to maintain a relatively constant number of grown stock as the breeding herd. Heifers were saved to replace old and barren mature cows which were culled out and sold. The main source of cash income from the enterprise was from the sale of calves at from four months to one year of age. The average weight of calves sold was 312 pounds; the average price received, $6.49 per 100 pounds; and the average amount received per head, $20.28. (Table 5). Most calf sales were made to local buyers, or to butchers or buyers in the local livestock auctions. In the Eastern area, part of the supply was shipped to the New Orleans market.

TABLE 5. NUMBER, WEIGHT, PRICE AND TOTAL VALUE OF CALVES SOLD ON 117 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.*

AREA	Number of calves sold	Average weight per head	Average price per pound	Average value per head
	Number	*Pounds*	*Cents*	*Dollars*
Eastern	740	275	6.34	17.43
Central	1,260	326	6.81	22.17
Delta	810	339	6.47	21.92
Rice	457	308	6.16	18.97
Cut-over	530	295	6.22	18.36
ALL AREAS	3,797	312	6.49	20.28

*Of the 197 farms surveyed, only 117 reported the sales of calves by weight.

Calves were sold at lighter weights per head and at relatively lower prices per pound in the Eastern and the Cut-over areas. The usual management practice in Eastern Louisiana was to sell spring calves in the early fall, so as to carry the cows through the winter in better shape, and to save on feed costs. In the Cut-over area, the calves were usually sold at about one year of age, the light weights being due to lower quality and less intensive feeding. These two areas produced less home-grown feed for winter use than the Central and the Delta areas, and had higher unit costs of producing feed, because of low yield.

Calves were sold at the heaviest weights per head and at the highest prices per pound in Central Louisiana and in the Delta. In these areas, the usual practice was to carry at least part of the calf crop through the winter, using some home-grown feed and purchased feed when necessary, so as to take advantage of the higher price per pound received from the sale of heavy calves in the early spring months.

Calf sales in the Rice area were mostly in November and December, and at the lowest average price per pound of all areas studied. Calf sales in the fall enabled producers to carry cows through the winter in better condition on the usual rice-stubble pasture and rice straw. Relatively little other feed was produced in this area for winter feeding of beef cattle.

The average seasonal price received for calves on the farms studied varied from $6.56 per 100 pounds in September to a low point of $6.01 in December, then increased rapidly in the winter and early spring months to $7.04 per 100 pounds in March, and declined to $6.52 per 100 pounds in June. (Table 6). The average price received for all calves sold during the twelve-months period under study was $6.49 per 100 pounds.

TABLE 6. SALES OF CALVES BY MONTHS ON 117 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.*

	Number of calves sold	Average weight per head	Average price per pound	Average value per head
	Number	*Pounds*	*Cents*	*Dollars*
September, 1939	469	304	6.56	19.93
October	833	311	6.41	19.92
November	442	296	6.16	18.21
December	347	310	6.01	18.66
January, 1940	50	318	6.48	20.60
February	80	343	6.77	23.20
March	85	358	7.04	25.22
April	304	329	6.75	22.19
May	288	306	6.96	21.30
June	215	328	6.52	21.36
July	319	316	6.56	20.74
August	365	309	6.57	20.30
TOTAL OR AVERAGE	3,797	312	6.49	20.28

*Only 117 of the 197 farmers surveyed reported sales of cattle by weights.

One-third of the calf sales were made in September and October, and more than half were sold by the end of December. These sales were made in the fall, in spite of the fact that relatively low prices were received, because the supply of feed and the pasture conditions were not sufficiently good to carry both the calves and the cows through the winter. In the areas where extensive beef cattle enterprises were maintained, the producers probably made greater returns by this sales policy, even though prices were lower, since the increased feed costs and the lowered vitality of the breeding herd in the spring would have more than offset the increase in returns. In areas where feed was more abundant and pastures were of better quality, such as in Central Louisiana and the Delta, it apparently paid the producers to carry part of the calf crop through the winter and sell for higher prices in the spring. Over any long period of time, however, there will be occasional severe winters which will result in higher mortality rates and increased feed costs which make such a practice unprofitable.

Net Operating Returns in Different Areas

The net operating returns averaged $828 per farm in (1) the Eastern area; $677 in (2) the Central area; $603 in (3) the Delta area; $676 in

(4) the Rice area; and $208 per farm in (5) the Cut-over area. Net operating returns per head of grown stock varied from $5.17 per head in Eastern Louisiana, to $2.50 per head in the Cut-over area.

Overhead costs were higher per farm and per head than the net operating return in all except the Cut-over area. This means that the net operating return was not large enough in most areas to pay five per cent interest return on the investment in cattle, pasture land, buildings, and water systems. It indicates, however, that in each area the enterprise did return between three and four per cent, after all costs except interest had been deducted.

FACTORS AFFECTING COSTS AND RETURNS ON THE BEEF CATTLE ENTERPRISE

Although the net operating return from the beef cattle enterprise was $576 per farm, or $4.18 per head of grown stock, all producers did not have the same costs or the same returns. Average costs and returns varied widely in the different areas studied. Also, within each area there were wide variations between individual farms. The farmers within each area had to pay about the same rate for feed and labor, had the same weather conditions, and sold their product on the same market, and yet differed widely in their ability to obtain good returns from the enterprise.

In order to determine why the enterprise produced high returns on some farms and relatively low returns on others, and to find out what factors were influencing returns, a study was made of changing costs and returns under different management conditions. To find the full effect of any one factor on costs and returns, it is necessary to keep the influence of other factors as nearly average as possible. This helps to make sure that the result obtained is due to the factor being studied and not to one or more of the other inter-related factors. Thus, the records were first grouped by areas, so as to eliminate the effect of type of farming, weather conditions, and marketing problems in the different areas.

To study the effect of each important factor on the costs and returns in each area, the records for each area were divided into two groups: those farms which were less than average for the particular factor being studied, and those farms which were average or above in this same factor. Tabulations were made for each group, in order to determine the effect of the factor studied on the individual items of cost and return. Other physical and financial factors were listed in each comparison as a check on their influence in causing variations.

The following analysis points out some of the factors responsible for the variations in costs and returns. Most of these factors are financial or management problems which individual farmers can control to some extent through proper use of their financial and physical resources and the application of well-tested experimental results to cattle production and management.

Relation of the Size of the Beef Cattle Herd to Costs and Returns

Managing a relatively large sized herd resulted in high net operating returns per farm and per head from the beef cattle enterprise. (Table 7). For example, farmers having less than average numbers of grown stock in the herd, an average of 79 head per farm, made a net operating return of $275 per farm, or $3.49 per head. In contrast, farmers with larger herds, an average of 238 head of grown stock per farm, returned $1,088 per farm, or $4.57 per head.

This favorable association between large size of herd and high returns per farm and per head of stock prevailed in each of the areas studied. Differences in returns on farms with small and with large herds were greater in the Eastern, Central, and Delta areas. These three areas had more intensive beef cattle enterprises, so that the net operating returns on farms with large herds were from $1.00 to $2.00 greater per cow than on farms with smaller herds. In areas with less intensive practices, the spread in returns for larger herds in comparison with smaller herds averaged less than $1.00 per cow.

Higher returns on farms with larger herds were due to the increase in gross returns and to cost economies made possible because of the larger volume of business. Farms with large herds had lower unit costs for man labor and for the upkeep of pastures and fences. Thus, the increased returns on the farms with larger than average sized herds were due to greater efficiency in the use of labor and in the use of pastures and fences, and to increased sales in relation to total costs.

The farms with larger herds had an average calving percentage of 59, as compared with 63 for farms with small herds, had slightly less total hours of man labor per head, the same mortality rates, about the same capital turnover, and an average value per head of $35, compared with $31 per head for the farms with small herds. These facts indicate that the differences in returns between the farms with small and large herds were due largely to size, since other factors were approximately the same in both size groups. (Table 8).

Relation of the Calving Percentage to Costs and Returns

For herds maintained principally for income obtained from the sale of surplus calves and non-breeding stock, the calves produced each year represent the main source of income. The number of calves raised to a saleable age in proportion to the number of cows on the farm during the breeding season is the best measure of the rate of production. The calving percentage, or the number of calves produced per hundred breeding cows, is a measure of production rates equivalent to the yield per acre of crops or the production of milk per cow for dairy herds. A high calving percentage is important in obtaining satisfactory returns.

The higher the calving percentage, the greater were the net operating returns per farm and per head from the beef cattle enterprise. (Table 9).

TABLE 7. RELATION OF SIZE OF HERD TO COSTS AND RETURNS PER HEAD OF BEEF CATTLE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

COSTS AND RETURNS PER HEAD	EASTERN		CENTRAL		DELTA		RICE		CUT-OVER		ALL AREAS	
	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Current costs:												
Livestock purchased	2.31	3.25	2.71	3.10	1.75	1.69	.63	2.05	.82	1.29	1.84	2.31
Home-grown feed	1.31	1.08	1.76	2.02	2.35	1.81	.50	.42	1.18	.89	1.57	1.33
Purchased feed	.70	.68	1.30	1.50	.91	.76	1.49	1.72	1.20	1.31	1.10	1.21
Man labor	.73	.54	.91	.90	.87	.85	.53	.67	.88	.72	.81	.76
Pasture upkeep	.85	.36	.80	1.02	1.07	.56	.49	.63	.12	.10	.73	.59
Marketing costs	.45	.78	.67	.52	.33	.59	.24	.54	.14	.19	.41	.54
Horse work	.24	.21	.26	.27	.22	.23	.12	.18	.17	.25	.22	.23
Other current costs	.26	.32	.90	.72	.43	.74	.45	.40	.25	.24	.52	.53
TOTAL CURRENT COSTS	6.85	7.22	9.31	10.05	7.93	7.23	4.45	6.61	4.76	4.99	7.20	7.50
Returns:												
Sales	8.10	10.72	9.91	10.16	7.55	11.42	6.73	8.83	6.02	5.87	8.00	9.71
Inventory increase	2.77	2.43	2.84	4.85	3.88	.19	1.57	2.40	1.20	1.66	2.69	2.37
TOTAL RETURNS	10.87	13.15	12.75	15.01	11.43	11.61	8.30	11.23	7.22	7.53	10.69	12.08
Net operating returns	4.01	5.94	3.44	4.96	3.51	4.38	3.85	4.61	2.46	2.54	3.49	4.57
Total overhead costs	5.75	4.82	6.24	6.27	7.38	5.57	4.82	5.06	1.68	1.85	5.62	5.03
NET RETURNS	−1.74	+1.12	−2.80	−1.31	−3.87	−1.19	− .97	− .45	+ .78	+ .69	−2.13	− .46
Current costs per farm	650	2,155	868	2,725	629	2,101	322	1,743	253	606	567	1,787
Total returns per farm	1,031	3,926	1,189	4,070	907	3,375	600	2,960	385	914	842	2,875
Net operating returns per farm	381	1,771	321	1,345	278	1,274	278	1,217	132	308	275	1,088
Overhead costs per farm	545	1,438	582	1,700	586	1,618	348	1,335	90	225	442	1,197
Net returns per farm	− 164	+ 333	− 261	− 355	− 308	− 344	− 70	− 118	+ 42	+ 83	− 167	− 109

TABLE 8. Relation of Size of Herd to Various Efficiency Factors of the Beef Cattle Enterprise, 197 Farms in Selected Areas in Louisiana, 1939-1940.

Area	Factor					
	Number of grown cattle	Calving percentage	Hours of man labor per head	Mortality rate	Capital turnover	Value per head of grown cattle
	Number	*Per cent*	*Hours*	*Per cent*	*Per cent*	*Dollars*
Eastern						
Less than average	95	59	6.9	8	21	32
Average or above	298	60	5.9	5	28	32
Central						
Less than average	93	72	8.3	10	24	32
Average or above	271	64	9.0	6	23	36
Delta						
Less than average	79	61	8.7	6	21	33
Average or above	291	59	6.9	5	27	40
Rice						
Less than average	72	61	4.3	6	20	31
Average or above	264	55	4.7	5	18	38
Cut-over						
Less than average	53	61	8.4	6	20	26
Average or above	121	57	7.5	11	20	28
All areas						
Less than average	79	63	7.6	7	21	31
Average or above	238	59	7.0	7	23	35

Those farms having a calving percentage below average, with 47 calves produced per hundred cows, made an average net operating return of $418 per farm, or $2.72 per head, as compared with $713 per farm, or $5.76 per head, for farms having a calving percentage above average, or producing 74 calves per hundred cows.

This relationship between calving percentages and returns per farm and per head existed in each of the areas studied. The increased returns varied from more than $5.00 per head in the Delta and $4.00 per head in Central Louisiana to less than $1.00 per head in the Cut-over area. The areas having the more intensive beef cattle enterprises, spending larger amounts for feed, pasture, and labor, made greater returns through relatively high calving percentages than the areas following less intensive practices.

The higher net operating returns for farms with relatively high rates of production for the beef cattle enterprise were due to increased sales of additional calves produced at a relatively small extra expense. Total costs per head for feed, man labor, pasture upkeep, and other current costs were higher for farms with high calving percentages, but total receipts more than offset the increased costs. These results indicate that the producers obtaining high calving percentages took better care of the herds, as is indicated by higher costs, use of more man labor per head, and the higher charges for feed and pasture.

The farms with high calving percentages had somewhat smaller herds than those obtaining relatively low percentages, indicating that the dif-

TABLE 9. Relation of Calving Percentage to Costs and Returns Per Head of Beef Cattle, 197 Farms in Selected Areas in Louisiana, 1939-1940.

Costs and returns per head	Eastern		Central		Delta		Rice		Cut-over		All areas	
	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Current costs:												
Livestock purchased	2.66	3.03	3.56	2.23	1.56	1.88	2.17	1.01	1.02	1.24	2.31	1.96
Home-grown feed	.89	1.39	1.56	2.33	1.76	2.27	.31	.61	.99	1.00	1.19	1.67
Purchased feed	.55	.80	1.72	1.07	.73	.91	1.20	2.25	.75	1.87	1.07	1.28
Man labor	.53	.69	.79	1.03	.82	.90	.68	.56	.72	.84	.73	.83
Pasture upkeep	.35	.70	.83	1.04	.76	.71	.51	.70	.09	.11	.58	.71
Marketing costs	.47	.78	.56	.62	.69	.27	.40	.55	.17	.17	.49	.49
Horse work	.18	.26	.20	.34	.22	.24	.16	.17	.23	.22	.20	.26
Other current costs	.27	.31	.62	.99	.71	.55	.34	.51	.23	.27	.48	.57
TOTAL CURRENT COSTS	5.90	7.96	9.84	9.65	7.25	7.73	5.77	6.36	4.20	5.72	7.05	7.77
Returns:												
Sales	6.97	11.73	8.19	12.24	8.67	11.48	7.46	9.29	5.09	6.89	7.57	10.75
Inventory increase	3.46	1.88	4.08	4.05	.19	2.96	1.77	2.70	1.56	1.42	2.21	2.78
TOTAL RETURNS	10.43	13.61	12.27	16.29	8.86	14.44	9.23	11.99	6.65	8.31	9.78	13.53
Net operating returns	4.53	5.65	2.43	6.64	1.61	6.71	3.46	5.63	2.45	2.59	2.72	5.76
Total overhead costs	5.55	4.92	5.78	6.82	4.94	7.60	5.01	4.97	1.70	1.89	4.82	5.69
NET RETURNS	−1.02	+ .73	−3.35	− .18	−3.33	− .89	−1.55	+ .66	+ .75	+ .70	−2.10	+ .07
Current costs per farm	1,043	1,193	1,808	1,265	1,221	1,015	1,031	826	355	461	1,084	963
Total returns per farm	1,842	2,039	2,253	2,137	1,492	1,897	1,649	1,557	562	670	1,502	1,676
Net operating returns per farm	799	846	445	872	271	882	618	731	207	209	418	713
Overhead costs per farm	980	736	1,061	894	831	999	895	646	144	153	741	705
Net returns per farm	− 181	+ 110	− 616	− 22	− 560	− 117	− 277	+ 85	+ 63	+ 56	− 323	+ 8

ferences in returns due to the variations in calving percentage were not influenced by increasing size of herd. (Table 10). Other important factors, including mortality rates, capital turnover, and quality of the cattle, as indicated by the inventory value per cow, were relatively constant.

TABLE 10. RELATION OF CALVING PERCENTAGE TO VARIOUS EFFICIENCY FACTORS ON THE BEEF CATTLE ENTERPRISE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

AREA	FACTOR					
	Number of grown cattle	Calving percentage	Hours of man labor per head	Mortality rate	Capital turnover	Value per head of grown cattle
	Number	*Per cent*	*Hours*	*Per cent*	*Per cent*	*Dollars*
Eastern						
Less than average	177	44	5.7	8	20	32
Average or above	150	70	7.1	6	26	32
Central						
Less than average	184	56	7.6	9	19	33
Average or above	131	81	9.4	9	27	33
Delta						
Less than average	168	44	6.8	7	24	33
Average or above	131	74	9.2	5	21	37
Rice						
Less than average	179	44	5.8	6	19	31
Average or above	130	71	3.2	5	19	37
Cut-over						
Less than average	85	47	6.9	7	18	27
Average or above	81	72	9.2	9	21	27
All areas						
Less than average	154	47	6.7	7	20	31
Average or above	124	74	7.9	7	23	33

Most of the cattlemen interviewed realized the importance of obtaining a relatively high calving percentage, and many different management practices were being used to improve the calf crop. Many producers were purchasing pure-bred bulls to improve the quality of the calves, and were increasing the number of bulls in relation to the number of cows. Others were leaving the bulls in the herd only part of the year to obtain a uniform calf crop at the time of the year when feed was most abundant. Some cattlemen stated that this practice, while desirable, resulted in obtaining a smaller calf crop, due to less chance of producing calves from irregular breeders and that, in some instances, it resulted in a few poor-quality calves, due to invasions from neighboring herds.

The desirable practice needed to improve calving rates is to remove the suckling calves from the cows at from three to five months of age. The most common practice now is to let the calves run with the cows until six to nine months of age, then either selling the calves or feeding them during the winter and selling on the spring market. The shorter period would assure bringing the breeding cows back into production the following spring. Such a practice might reach a calving percentage of from 80 to 90 per cent, but, in practice, this would be hard to maintain over a period of years. With the more commonly prevailing practice, the calf crop has the tendency to come later each year, since all the breeding herd usually are not bred within three months, although such is possible for the best management, after the last calf is produced under the usual range and pasture conditions. As a result, within a few years a very late calf crop results, which must be carried through the winter at a relatively high feed cost per head. Also, there are very few cows which will not skip production in one year out of every four or five, and a few non-producers in the herd, if not detected within the year, will tend to lower the average calving rate for the entire herd.

Within the actual practice of the farms studied, it seems that a calving percentage of 70 to 80 is the highest rate that can be expected to be maintained over a period of years, and that such a high rate of production can be maintained only by careful selection, management, and continual culling of non-breeders. When producing cattle under open-range conditions, a rate somewhat lower than this is to be expected, since the extra costs needed would probably more than offset the increase in returns.

Relation of the Hours of Man Labor Per Head to Costs and Returns

Since the cost of labor is an important item of expense for the beef cattle enterprise, the hours of man labor used per head of grown stock is a reliable indication of the efficiency in the use of labor, and, indirectly, of the efficiency of other management practices.

The lower the hours of man labor used per head, within the actual practice of the farms studied, the greater were the net operating returns per farm and per head. Those farmers using less than average amounts of man labor per cow, 4.1 hours, made an average net operating return of $599 per farm, or $4.54 per head, as compared with $542 per farm, or $3.70 per head, for those with labor requirements average or above, 12.3 hours.[3] (Table 11).

These facts indicate that efficiency in the use of labor paid dividends in the form of lower costs and higher net returns. The farmers obtaining relatively high labor efficiency had lower costs per head for man labor, horse work, pasture and fence upkeep, and marketing costs than those with large amounts of labor used per cow and low labor efficiency. The differences in returns were due not only to savings made on labor costs, but also to the fact that the farms obtaining high labor efficiency also were more efficient in the use of horse work, the management of fences and pastures, and in marketing calves and cull cattle.

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[3] In so far as labor is supplied by the operator and his family, the larger cost, due to more hours of labor, represents an increased return to them, even though it reduces the net operating returns for the enterprise.

TABLE 11. Relation of Hours of Man Labor Per Head to Costs and Returns Per Head of Beef Cattle, 197 Farms in Selected Areas in Louisiana, 1939-1940.

Costs and returns per head	Eastern		Central		Delta		Rice		Cut-over		All areas	
	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Current costs:												
Livestock purchased	3.82	1.61	3.17	2.61	1.77	1.65	.45	3.49	1.12	1.12	2.15	2.13
Home-grown feed	1.07	1.31	1.76	2.15	2.66	1.32	.47	.40	.89	1.14	1.47	1.34
Purchased feed	.37	1.13	1.18	1.80	.50	1.15	1.89	1.31	1.54	.89	1.08	1.30
Man labor	.35	.98	.67	1.26	.56	1.17	.42	.95	.44	1.27	.51	1.13
Pasture upkeep	.48	.65	.87	1.03	.71	.77	.63	.56	.11	.08	.61	.69
Marketing costs	.50	.84	.53	.65	.51	.47	.36	.59	.19	.13	.45	.55
Horse work	.11	.38	.24	.31	.12	.34	.12	.22	.09	.41	.15	.33
Other current costs	.31	.75	.58	1.12	.72	.54	.39	.45	.26	.25	.49	.57
TOTAL CURRENT COSTS	7.01	7.65	9.00	10.93	7.55	7.41	4.73	7.97	4.64	5.29	6.91	8.04
Returns:												
Sales	8.99	10.25	9.72	10.58	9.37	10.71	8.76	7.49	6.00	5.82	8.82	9.46
Inventory increase	4.85	.33	2.51	6.47	2.82	.17	1.11	3.78	2.07	.67	2.63	2.28
TOTAL RETURNS	13.84	10.58	12.23	17.05	12.19	10.88	9.87	11.27	8.07	6.49	11.45	11.74
Net operating returns	6.83	2.93	3.23	6.12	4.64	3.47	5.14	3.30	3.43	1.20	4.54	3.70
Total overhead costs	4.83	5.67	6.03	6.61	6.42	6.01	4.75	5.37	1.81	1.76	5.09	5.44
NET RETURNS	+2.00	−2.74	−2.80	− .49	−1.78	−2.54	+ .39	−2.07	+1.62	− .56	− .55	−1.74
Current costs per farm	1,124	1,225	1,445	1,612	876	1,546	719	1,241	396	418	911	1,180
Total returns per farm	2,220	1,694	1,963	2,515	1,414	2,270	1,501	1,755	690	513	1,510	1,722
Net operating returns per farm	1,096	469	518	903	538	724	782	514	294	95	599	542
Overhead costs per farm	776	908	967	975	745	1,254	722	836	155	139	671	798
Net returns per farm	+ 320	− 439	− 449	+ 72	− 207	− 530	+ 60	− 322	+ 139	− 44	− 72	− 256

This does not mean that the cattlemen who neglected their herds and worked very little on the enterprise made the greatest return. It indicates that, for a given intensity of the enterprise, the producer who had more efficient pasture systems, resulting in lower labor requirements, and who planned his work in advance made greater returns for the total labor used.

Farmers with relatively high labor efficiency made higher operating returns per farm and per head in four of the five areas studied. The Central area was an exception. (Table 12). The group with less than average hours of labor per head had a calving percentage of 65, compared with 75 for the farms using large amounts of man labor per cow. There is a practical limitation in the extent to which labor efficiency in terms of hours per cow can be increased. In instances where labor costs are reduced by neglecting the herd, it might result in lowering the calving percentage, so that the lower expenses are more than offset by lower returns.

TABLE 12. RELATION OF HOURS OF MAN LABOR PER HEAD TO VARIOUS EFFICIENCY FACTORS ON THE BEEF CATTLE ENTERPRISE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

AREA	FACTOR					
	Number of grown cattle	Calving percentage	Hours of man labor per head	Mortality rate	Capital turnover	Value per head of grown cattle
	Number	*Per cent*	*Hours*	*Per cent*	*Per cent*	*Dollars*
Eastern						
Less than average	160	62	3.4	5	24	33
Average or above	160	57	10.8	10	23	32
Central						
Less than average	161	65	5.3	10	24	33
Average or above	147	75	13.1	8	22	33
Delta						
Less than average	116	58	4.1	5	22	33
Average or above	209	64	15.6	7	24	40
Rice						
Less than average	152	60	2.3	5	19	35
Average or above	156	56	7.8	6	19	32
Cut-over						
Less than average	85	56	4.4	6	18	28
Average or above	79	63	12.7	10	22	26
All areas						
Less than average	132	60	4.1	6	22	32
Average or above	147	64	12.3	8	22	32

Mortality rates were slightly higher on farms with high labor efficiency in the Central area, which is another indication that the use of labor on these farms was not sufficient to care adequately for the herd.

Relation of Mortality Rates of Beef Cattle to Costs and Returns

The number of cattle which die during the year from diseases or other causes, such as underfeeding, bogging-down, train and automobile

TABLE 13. RELATION OF MORTALITY RATES OF BEEF CATTLE TO COSTS AND RETURNS PER HEAD, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

COSTS AND RETURNS PER HEAD	EASTERN		CENTRAL		DELTA		RICE		CUT-OVER		ALL AREAS	
	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Current costs:												
Livestock purchased	3.14	2.52	2.91	3.02	2.17	.94	1.10	2.44	1.18	1.04	2.22	2.01
Home-grown feed	.96	1.46	1.94	1.87	2.20	1.67	.29	.65	.95	1.05	1.44	1.37
Purchased feed	.79	.57	1.10	2.08	1.04	.43	1.53	1.82	1.45	1.04	1.16	1.20
Man labor	.58	.67	.84	1.02	1.04	.54	.71	.52	.71	.87	.82	.72
Pasture upkeep	.47	.66	.95	.89	.76	.72	.64	.53	.13	.07	.67	.61
Marketing costs	.72	.54	.63	.47	.54	.41	.59	.28	.17	.16	.55	.39
Horse work	.21	.24	.27	.27	.23	.23	.18	.15	.17	.30	.22	.23
Other current costs	.33	.24	.83	.71	.46	2.13	.47	.34	.25	.25	.53	.53
TOTAL CURRENT COSTS	7.20	6.90	9.47	10.33	8.44	7.07	5.51	6.73	5.01	4.78	7.61	7.06
Returns:												
Sales	9.49	9.91	10.41	9.34	9.62	10.72	9.49	6.59	6.85	4.75	9.46	8.52
Inventory increase	4.35	.18	4.94	2.30	3.13	.....	1.26	3.41	2.16	.65	3.40	1.05
TOTAL RETURNS	13.84	10.09	15.35	11.64	12.75	10.72	10.75	10.00	9.01	5.40	12.86	9.57
Net operating returns	6.64	3.19	5.88	1.31	4.31	3.65	5.24	3.27	4.00	.62	5.25	2.51
Total overhead costs	4.67	5.89	6.76	5.25	6.73	5.35	5.87	3.82	1.87	1.69	5.67	4.56
NET RETURNS	+1.97	−2.70	− .88	−3.94	−2.42	−1.70	− .63	− .55	+2.13	−1.07	− .42	−2.05
Current costs per farm	1,322	945	1,614	1,357	1,250	1,051	843	1,036	377	450	1,078	932
Total returns per farm	2,541	1,382	2,616	1,528	1,887	1,595	1,645	1,542	679	509	1,822	1,263
Net operating returns per farm	1,219	437	1,002	171	637	544	802	506	302	59	744	331
Overhead costs per farm	857	807	1,152	689	996	796	899	588	141	159	804	602
Net returns per farm	+ 362	− 370	− 150	− 518	− 359	− 252	− 97	− 82	+ 161	− 100	− 60	− 271

collisions and other accidents, affects directly the returns from the enterprise. In this study, mortality rates were measured in terms of the percentage of the breeding cows on hand at the beginning of the year which died during the year.

Average mortality rates varied from nine per cent in Central Louisiana, to five per cent in the Rice area.

Lower mortality rates per farm were associated with greater net operating returns per farm and per head of beef cattle. Those farmers having less than average mortality rates, two per cent, made an average net operating return of $774 per farm, or $5.35 per head, as compared with $331 per farm, or $2.51 per head, for those with mortality rates average or above, 14 per cent. (Table 13).

The relationship between low mortality rates and higher net operating returns per farm and per head applied in each of the areas studied. The increased returns made on the farms with low mortality rates varied from more than $4.00 per head in the Central area, to less than $1.00 per head in the Delta area. Variations were greater in the Central area because of a higher average mortality rate in this region and more variation between individual farms. In this area, the farmers reporting low mortality rates lost only three per cent of the original herd, while those having deaths average or above lost 18 per cent of the herd. (Table 14).

TABLE 14. Relation of Mortality Rates of Beef Cattle to Various Efficiency Factors on the Beef Cattle Enterprise, 197 Farms in Selected Areas in Louisiana, 1939-1940.

Area	Factor					
	Number of grown cattle	Calving per-centage	Hours of man labor per head	Mortality rate	Capital turnover	Value per head of grown cattle
	Number	*Per cent*	*Hours*	*Per cent*	*Per cent*	*Dollars*
Eastern						
Less than average	184	63	7.6	2	24	32
Average or above	137	56	5.5	12	23	32
Central						
Less than average	170	69	8.9	3	26	35
Average or above	131	69	8.1	18	20	30
Delta						
Less than average	148	61	9.1	2	23	35
Average or above	149	58	6.5	12	21	35
Rice						
Less than average	153	60	4.7	1	20	36
Average or above	154	55	4.2	12	19	31
Cut-over						
Less than average	75	59	7.1	2	21	26
Average or above	94	59	9.4	17	17	28
All areas						
Less than average	142	63	7.7	2	23	33
Average or above	132	60	6.9	14	20	31

These results indicate that cattlemen must hold the mortality rates at a low level if a good return is expected from the enterprise. The producers reported that highest losses occurred in the late winter months, due to the poor condition of the cattle, and that losses could be reduced by proper management, including the selling of all old and weak animals, guarding against over-pasturing in the fall and winter, bringing the cows up to the winter season in good shape by sufficient summer pasture, providing some shelter if possible during severe winter days, and the feeding of weak animals.

Relation of the Capital Turnover of the Herd to Costs and Returns

A commercial farm enterprise of any kind must necessarily produce some cash return every year if it is to be profitable, since an increased inventory value is only a theoretical return until an actual cash sale is made. Capital turnover is a measure of the rate of sales in proportion to the investment in the herd, and is developed by computing the percentage that total sales for the year were of the average inventory value of grown stock. It is an indication of how rapidly the investment in beef cattle is being turned into cash or how efficiently the capital invested in cattle is being used. It is also an indirect indication of how frequently the herd is being culled and of how many calves are being produced for marketing.

The larger the sales in relation to average inventory values, or the higher the capital turnover, the greater were the net operating returns per farm and per head. Those farms having a relatively low capital turnover, a rate of 12 per cent, received a net operating return of $494 per farm, or $3.65 per head, as compared with $673 per farm, or $4.79 per head, for the farms with a highly favorable capital turnover, 33 per cent. (Table 15).

This relationship between high rates of capital turnover and high returns per farm and per head existed in each of the areas studied. Since the farms with high capital efficiency also showed slightly higher calving percentages in most areas, not all of the difference in returns between the low and high capital groups was due to differences in sales management. (Table 16). Much of the difference, however, can be attributed to the management practices of the high capital efficiency group in making frequent sales, continually replacing old stock, and in selling when prices were relatively high.

Relation of the Quality of the Cattle to Costs and Returns

A reliable measure of the quality of cattle is hard to determine, because of the wide differences in individual animals, the many different types and breeds usually represented in any one herd, and differences in condition at different times of the year, depending upon the pasture season and the amount of feed available. A rough measure can be

TABLE 15. RELATION OF SALES IN PER CENT OF INVENTORY VALUE OR CAPITAL TURNOVER TO COSTS AND RETURNS PER HEAD OF BEEF CATTLE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

COSTS AND RETURNS PER HEAD	EASTERN		CENTRAL		DELTA		RICE		CUT-OVER		ALL AREAS	
	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Current costs:												
Livestock purchased	2.17	3.70	3.14	2.69	1.88	1.52	.30	3.01	1.02	1.22	1.90	2.41
Home-grown feed	1.30	1.02	1.16	2.93	1.80	2.24	.68	.21	1.42	.57	1.29	1.56
Purchased feed	.56	.85	1.30	1.59	.90	.73	1.57	1.74	.99	1.56	1.08	1.28
Man labor	.61	.64	.96	.83	.83	.89	.52	.74	.80	.76	.77	.78
Pasture upkeep	.58	.52	.90	.97	.62	.87	.48	.70	.09	.11	.60	.70
Marketing costs	.48	.77	.55	.62	.39	.60	.20	.72	.16	.17	.39	.61
Horse work	.22	.23	.24	.31	.19	.27	.11	.22	.26	.19	.20	.25
Other current costs	.30	.36	.63	1.00	.41	5.16*	.33	.49	.28	.72	.43	1.40
TOTAL CURRENT COSTS	6.22	8.09	8.88	10.94	7.02	12.28	4.19	7.83	5.02	5.30	6.66	8.99
Returns:												
Sales	5.47	14.59	5.99	15.53	4.39	16.51	5.15	11.30	3.25	8.64	5.00	13.78
Inventory increase	4.77	.....	6.55	.73	6.55	.....	3.34	1.04	3.47	.....	5.31	.....
TOTAL RETURNS	10.24	14.59	12.54	16.26	10.94	16.51	8.49	12.34	6.72	8.64	10.31	13.78
Net operating returns	4.02	6.50	3.66	5.32	3.92	4.23	4.30	4.51	1.70	3.34	3.65	4.79
Total overhead costs	5.23	5.15	5.68	7.04	5.44	7.12	5.93	4.08	1.73	1.85	5.09	5.41
NET RETURNS	−1.21	+1.35	−2.02	−1.72	−1.52	−2.89	−1.63	+ .43	− .03	+1.49	−1.44	− .62
Current costs per farm	886	1,521	1,579	1,448	949	2,049	617	1,252	399	456	903	1,263
Total returns per farm	1,459	2,742	2,229	2,152	1,479	2,755	1,251	1,973	534	744	1,397	1,936
Net operating returns per farm	573	1,221	650	704	530	706	634	721	135	288	494	673
Overhead costs per farm	744	968	1,010	932	736	1,187	874	653	138	159	689	760
Net returns per farm	− 171	+ 253	− 360	− 228	− 206	− 481	− 240	+ 63	− 3	+ 129	− 195	− 87

*Due to heavy sales of stock out of inventory.

TABLE 16. RELATION OF SALES IN PER CENT OF INVENTORY VALUE OR CAPITAL TURNOVER TO VARIOUS EFFICIENCY FACTORS ON THE BEEF CATTLE ENTERPRISE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

AREA	FACTOR					
	Number of grown cattle	Calving percentage	Hours of man labor per head	Mortality rate	Capital turnover	Value per head of grown cattle
	Number	*Per cent*	*Hours*	*Per cent*	*Per cent*	*Dollars*
Eastern						
Less than average	142	58	7.1	8	15	31
Average or above	188	62	5.7	6	37	34
Central						
Less than average	178	66	8.7	8	13	34
Average or above	132	72	8.4	9	34	32
Delta						
Less than average	135	61	7.2	7	13	34
Average or above	167	60	9.4	5	37	37
Rice						
Less than average	147	56	4.8	6	12	35
Average or above	160	60	4.1	5	27	33
Cut-over						
Less than average	80	58	8.0	8	10	28
Average or above	86	61	8.0	7	30	26
All areas						
Less than average	135	60	7.3	7	12	32
Average or above	141	64	7.4	7	33	32

obtained, however, by obtaining the average inventory value per head. A herd with an average value of $25 per head can be considered as inferior in quality, breeding, and productive capacity to a herd with an average value of $40 per head.

The higher the quality of the cattle per farm, as measured by the average beginning inventory value per head, the greater were the net operating returns per farm and per head. Farmers having less than average values per head of stock, $26 per head, reported net operating returns of $356 per farm, or $2.91 per head, as contrasted with $799 per farm, or $5.22 per head, for the group having higher-quality cattle, $39 per head. (Table 17).

Farmers possessing relatively high-quality cattle made significantly higher net operating returns per head in four of the five areas. In the Cut-over region, there was little difference in returns between the low- and high-quality groups. This area, in contrast to the others, showed little variation in quality. It was practically impossible to maintain herds at noticeably higher-than-average quality because of the open-range conditions under which the cattle were pastured.

Cattle of higher quality were associated with the larger sized herds in four of the five areas studied. (Table 18). Producers with relatively large herds usually could afford to purchase improved bulls and use improved management practices to a greater extent than cattlemen with small herds. Also, better calving percentage was obtained in most areas

TABLE 17. RELATION OF VALUE PER HEAD OF GROWN STOCK TO COSTS AND RETURNS PER HEAD OF BEEF CATTLE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

COSTS AND RETURNS PER HEAD	EASTERN		CENTRAL		DELTA		RICE		CUT-OVER		ALL AREAS	
	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above	Less than average	Average or above
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Current costs:												
Livestock purchased	2.61	3.09	3.62	2.43	1.95	1.50	1.49	1.77	1.09	1.15	2.29	2.02
Home-grown feed	1.62	.81	1.60	2.16	1.21	2.73	.61	.34	.82	1.16	1.22	1.57
Purchased feed	.52	.83	1.63	1.26	.65	.97	1.19	1.95	.97	1.56	1.01	1.30
Man labor	.61	.63	.96	.85	.74	.96	.66	.61	.88	.68	.78	.77
Pasture upkeep	.52	.57	.76	1.05	.53	.93	.46	.68	.11	.09	.52	.75
Marketing costs	.36	.88	.42	.71	.61	.38	.22	.61	.10	.24	.38	.58
Horse work	.22	.23	.25	.28	.20	.25	.12	.19	.24	.21	.21	.24
Other current costs	.22	.36	.84	.76	.68	.64	.34	.46	.23	.26	.53	.53
TOTAL CURRENT COSTS	6.68	7.40	10.08	9.50	6.57	8.36	5.09	6.61	4.44	5.35	6.94	7.76
Returns:												
Sales	7.77	11.24	8.86	10.99	6.52	13.24	5.18	10.16	6.20	5.66	7.07	10.74
Inventory increase	2.36	2.73	3.86	4.22	3.23	.....	2.29	2.11	1.05	1.92	2.78	2.24
TOTAL RETURNS	10.13	13.97	12.72	15.21	9.75	13.24	7.47	12.27	7.25	7.58	9.85	12.98
Net operating returns	3.45	6.57	2.64	5.71	3.18	4.88	2.38	5.66	2.81	2.23	2.91	5.22
Total overhead costs	4.69	5.61	5.22	7.06	4.68	7.64	5.06	4.96	1.67	1.91	4.44	5.89
NET RETURNS	−1.24	+ .96	−2.58	−1.35	−1.50	−2.76	−2.68	+ .70	+1.14	+ 32	−1.53	− .67
Current costs per farm	1,043	1,213	1,367	1,659	1,021	1,190	581	1,291	317	522	851	1,189
Total returns per farm	1,582	2,290	1,725	2,655	1,515	1,884	852	2,398	518	739	1,207	1,988
Net operating returns per farm	539	1,077	358	996	494	694	271	1,107	201	217	356	799
Overhead costs per farm	732	919	708	1,234	726	1,087	577	969	119	186	544	901
Net returns per farm	− 193	+ 158	− 350	− 238	− 232	− 393	− 306	+ 138	+ 82	+ 31	− 188	− 102

TABLE 18. RELATION OF VALUE PER HEAD OF GROWN STOCK TO VARIOUS EFFICIENCY FACTORS ON THE BEEF CATTLE ENTERPRISE, 197 FARMS IN SELECTED AREAS IN LOUISIANA, 1939-1940.

AREA	FACTOR					
	Number of grown cattle	Calving per-centage	Hours of man labor per head	Mortality rate	Capital turnover	Value per head of grown cattle
	Number	*Per cent*	*Hours*	*Per cent*	*Per cent*	*Dollars*
Eastern						
Less than average	156	55	6.7	9	18	29
Average or above	164	64	6.4	6	28	35
Central						
Less than average	136	66	9.1	11	24	27
Average or above	175	72	8.0	7	23	40
Delta						
Less than average	155	57	6.2	8	22	27
Average or above	142	63	9.7	4	23	42
Rice						
Less than average	114	53	5.5	8	20	26
Average or above	195	63	3.4	3	18	42
Cut-over						
Less than average	71	62	8.7	8	22	24
Average or above	97	55	7.1	8	17	31
All areas						
Less than average	123	59	7.4	8	22	26
Average or above	153	64	7.3	6	22	39

where high quality cattle predominated. Thus, all of the difference in returns between the low- and high-quality groups cannot be traced to differences in quality directly, but was due somewhat to the interrelated factors, including larger sized herds and higher calving percentages.

SUMMARY AND CONCLUSIONS

The net returns from the beef cattle enterprise on the 197 farms studied, for the year ending with August, 1940, after deducting all current or operating costs, averaged $576 per farm, or $4.18 per head of grown stock. For cattlemen operating without borrowed capital, this represents the return from the enterprise for management and for investment in land, livestock, buildings, and equipment used in the process. The farm operator earned, in addition, an amount equal to the sum charged as a cost for his own and any other unpaid family labor.

If overhead costs, including interest at five per cent on the investment in pasture land, livestock, and buildings and fences used by the enterprise, are charged, a net loss of about $1.00 per head resulted. Since many of the farmers used their own resources and probably did not expect a rate of return of five per cent on capital which, if not used by the enterprise, would have been idle, this net loss is not a true indication of the opportunity to increase the income, although it is an accurate result from the accounting standpoint. If overhead costs had been computed on the basis of four per cent interest charges, all costs would have been covered by the returns. This indicates that the beef cattle enterprise, on the average, actually paid all costs, including a charge for the labor of the operator and unpaid family labor, and made a return of about four per cent on the investment in pasture land, cattle, buildings, and fences used by the enterprise.

All producers did not make the same net returns. The net operating returns per head of grown stock by areas were: $5.17 in the Eastern area; $4.41 per head in the Rice area; $4.36, in the Central area; $4.05, in the Delta area; and $2.50 per head in the Cut-over area of Southwest Louisiana.

Within each area, there were wide variations in returns. The most favorable net returns per farm and per head were found for farms with larger than average sized herds; calving percentage of more than 60 per cent; more efficient use of labor, horses, and pasture; low mortality rates; a relatively high capital turnover; and high-quality cows.

From the standpoint of the one-family cotton farm, the advisability of adding the beef cattle enterprise to the farm business seems doubtful in cases where it would necessitate the displacement of other enterprises or the acquisition of additional land. Assuming that a necessary economic unit of the beef cattle enterprise would be 20 cows and one bull, and that the average net operating returns would approximate those obtained on the farms studied in 1940, which were probably higher than will be obtained over a period of years, the enterprise would yield average net operating returns of about $4.00 per cow over all current costs, or total net returns of about $80. To obtain that return or increase of $80 in farm income, the small cotton farmer would, in many cases, have to purchase additional livestock and purchase or rent additional land, or use land now in other enterprises. Also, the usual cotton farmer, especially in areas where feed crop yields are low, would find it difficult to develop the needed skills in livestock management and, as a result, would probably find that the costs would exceed the returns if he attempted to change his type of farming over a short period of time.

For other producers, if additional land, equipment, and livestock must be purchased to expand the enterprise, there is danger of incurring a loss, since the overhead costs, high-priced land, and capital to purchase stock may offset all the other advantages. The farms studied were larger than the average family-sized farm in the state, and the operators had a larger amount of otherwise idle land to use. Similar returns could not be expected on all farms throughout the state, and even some of those studied failed to cover all overhead costs computed at interest rates which they would have had to pay to borrow money to finance the enterprise. Also, the average prices received for beef cattle in Louisiana during the 1939-40 season were the highest that had been obtained since 1929. It was a period of relatively small supplies of marketable beef throughout the United States. Over a long period of time, however, farmers tend to adjust the production of beef cattle to meet the demand, and beef cattle prices cannot be expected to remain at the high levels of 1940. In a period of lower prices, the relative returns from beef cattle on the farms studied would no doubt be much lower than those obtained in 1940.

The results of this study indicate that the beef cattle enterprise was a relatively profitable one on the farms studied during the 1939-40 season. On the farms where crop acreage restrictions had resulted in considerable idle land and equipment, the addition of beef cattle to the farm business served to utilize this idle land and equipment to good advantage and, in addition, provided another outlet for use of the available labor and workstock on the farm. An enterprise which pays all costs of production and makes a return of even one per cent on capital which could not be used in any other way will result in greater total returns on the farm for the year.

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Internal Breakdown of Sweet Potatoes Due to Exposure to Cold

By

W. D. KIMBROUGH AND MARION F. BELL

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INTERNAL BREAKDOWN OF SWEET POTATOES DUE TO EXPOSURE TO COLD

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W. D. Kimbrough and Marion F. Bell

INTRODUCTION

About the middle of January, 1940, an extremely cold spell swept over the South and continued for about two weeks. It was accompanied near the start in south Louisiana by high winds which enabled the cold to penetrate quickly buildings in which there were cracks or unclosed ventilators. Minimum temperatures of 15°, 17°, and 19° F. were recorded on successive days. In general, artificial heat is not considered necessary in sweet potato storage houses in south Louisiana and in many of the houses no provision has been made for heating. Sweet potatoes are often stored in houses which do not meet standard requirements for sweet potato storage.

Anxiety was felt for stored sweet potatoes soon after the cold weather struck. Many potatoes from storage houses when cut did not show normal latex, in fact little or none was often observed on the cut surface. This is commonly believed to indicate injury from cold. A few weeks later many potatoes were found to have various stages of internal breakdown. This breakdown was considered to be due to causes of physiological origin. The outside of the potatoes might seem entirely normal, while the interior had broken down. Some of these roots when bedded produced some sprouts but not a normal amount of them.

At the Louisiana Agricultural Experiment Station one lot of sweet potatoes of the Porto Rico variety had been stored in a sweet potato storage house and another lot in a storage room at the Agricultural Center. Neither lot received artificial heat, but the storage rooms in the Agricultural Center were well protected from sudden changes in temperature while the storage house was not. An examination in March showed that all roots in the storage house and that were cut were affected by internal breakdown while no injury was found in roots of those stored in the Agricultural Center. The breakdown seemed to be due to exposure to cold above the freezing point or to super-cooling without subsequent formation of ice crystals. As no description of similar type of injury was found and because there was some doubt about the possibility of cold being the causal factor it was thought best to determine whether similar injury could be induced by cold experimentally.

REVIEW OF LITERATURE

Harter, Weimer, and Adams (2) found that a number of fungi caused decay in sweet potatoes in three to six weeks when the potatoes were stored at 0° to 8° C. (32° to 46.4° F.). As these temperatures are not best suited for the growth of the organisms it indicates some change in the potatoes which makes them more favorable for their growth.

Price (5) reported that sweet potatoes of the Triumph variety exposed to temperatures ranging from 32° F. to 40° F. for periods not exceeding 10 hours were not injured. He recommended that the temperature in storage should not go below 40° F. He found severe injury to sweet potatoes of both the Triumph and Porto Rico varieties that were not dug until several days after a killing frost, if vines were not cut on or previous to the day of frost. Some of the injury was a form of internal breakdown.

Lauritzen (4) did a great deal of work on the effects of chilling temperatures on sweet potatoes. In his experiments he used the Jersey type of sweet potatoes and found evidence to indicate that there might be chilling injury other than the increased susceptibility to certain rot organisms when potatoes were stored at temperatures of —0.2° to 9.5° C. (31.6° to 49.1° F.). He stated that such signs of injury may not become evident after the chilling until the potatoes were put back at a temperature favorable for their storage. The injury was evidenced by internal browning of the tissue. As a result of his findings he concluded that the exposure of sweet potatoes for periods of less than 10 days at temperatures above the freezing point would not be injurious.

Harter and Weimer (1) described an internal breakdown of sweet potatoes the cause of which they attributed to relatively low humidity and high temperature in storage. They found some variation in varietal susceptibility to internal breakdown.

PROCEDURE

In October, 1940, sweet potatoes of the Porto Rico variety to be used in this work were dug. A number of crates were placed in a storage house which could be heated with electric strip heaters. Others were placed at different storage temperatures that were supposed to be constant at from 28° to 40° F. The temperature controls were not entirely accurate, especially at the lower temperatures, and some of the potatoes were frozen. An attempt was made to keep potatoes at low temperature for a time and then let the temperature rise slowly as it did the previous winter in many storage houses. Both cured and uncured potatoes were used.

In 1941 Porto Rico sweet potatoes were dug in October and placed in a storage house. They were left in the storage house until December 19 when it was found possible to use cold storage rooms in the Animal Industry Building during the Christmas holidays. The potatoes were exposed to the following temperatures:

Six crates of potatoes were placed at 40° F. Two crates were removed after one week, two crates were removed after two weeks, and the other crates were removed after three weeks.

Two crates of potatoes were stored at 34° F. One week later one crate was removed from cold storage and the other was placed at 40° F. for a week.

Two crates of potatoes were kept at 32° F. for one week. One crate was removed from cold storage and the other was placed at 40° F. for one week.

Two crates of potatoes were placed at 30° F. After one week one crate was removed from cold storage and the other was moved to 40° F. for one week.

Four crates of potatoes were left in the sweet potato storage house as checks.

When potatoes were removed from cold storage they were put back into the sweet potato house.

Potatoes from all treatments were examined February 3, 1942, and again March 19, 1942.

RESULTS OBTAINED IN 1940

Unsatisfactory results were obtained with uncured potatoes that were placed at cold storage temperatures soon after they were dug, because of decay. This was probably due to wounds not healing at low temperature and subsequent susceptibility to rot organisms. Thermostats at the lower temperatures did not work well in all cases and some potatoes were frozen. The frozen potatoes were lost on thawing. Better results were obtained with cured potatoes. It was found that it was possible to obtain injury in both uncured and cured potatoes by exposure to cold above the freezing point. Potatoes might seem all right from external appearances but little or no latex was present when they were cut. The cut surface was watery and had the appearance of being dead. Pithiness was often found in roots that had been exposed to cold storage temperatures and a few cases of internal breakdown were found. The best examples of this breakdown were in potatoes that had been exposed to 35° F. for 10 days to two weeks and then kept in the sweet potato house for several weeks. No cases of severe internal breakdown were found similar to the worst of that found in stored potatoes the previous winter.

1941 RESULTS

When the potatoes were examined February 3, 1942, the check potatoes were found to be in excellent condition.

The potatoes that had been kept at 40° F. for one week had no apparent injury. Those that had been kept at 40° F. for two weeks were variable. A few new sprouts were starting out but old sprouts were dead. Latex was present in some potatoes but not in others. The cut surface was watery. Potatoes kept at 40° F. for three weeks had no sprouts, there was very little latex in the potatoes, and cut surfaces were watery.

Potatoes which received all the other treatments had no sprouts, no latex, and the cut surfaces were watery. Many rotten potatoes were present in the lots of from 30°, 32°, and 34° F. storage but those that were kept at 40° F. for a week before being put back in the sweet potato house had fewer rotten potatoes than those taken directly from the lower temperatures.

There was no sign of typical internal breakdown.

Potatoes were examined again March 19. The results are shown in Table 1.

TABLE 1. CONDITION OF SWEET POTATOES EXAMINED MARCH 19, 1942

TREATMENT	SPROUTS	LATEX	CUT SURFACE—APPEARANCE
Check—no cold exposure	Normal	Normal	Normal
40° F. one week	Normal	Normal	Cut surface did not dry smoothly. Cavities in the larger potatoes.
40° F. two weeks	Few live sprouts	Practically none	Water soaked appearance. Some cavities.
40° F. three weeks	Very few live sprouts	None	Had dead appearance. Most of potatoes were solid.
34° F. one week	Very few live sprouts	Practically none	Internal breakdown present in many potatoes.
34° F. one week 40° F. one week	No sprouts	None	Typical internal breakdown in many potatoes.
32° F. one week	Very few live sprouts	None	Dead appearance, but mostly solid.
32° F. one week 40° F. one week	None	None	Dead appearance, but not hollow.
30° F. one week	None	None	Dead appearance but fairly solid.
30° F. one week 40° F. one week	One live sprout found	None	Dead appearance but fairly solid.

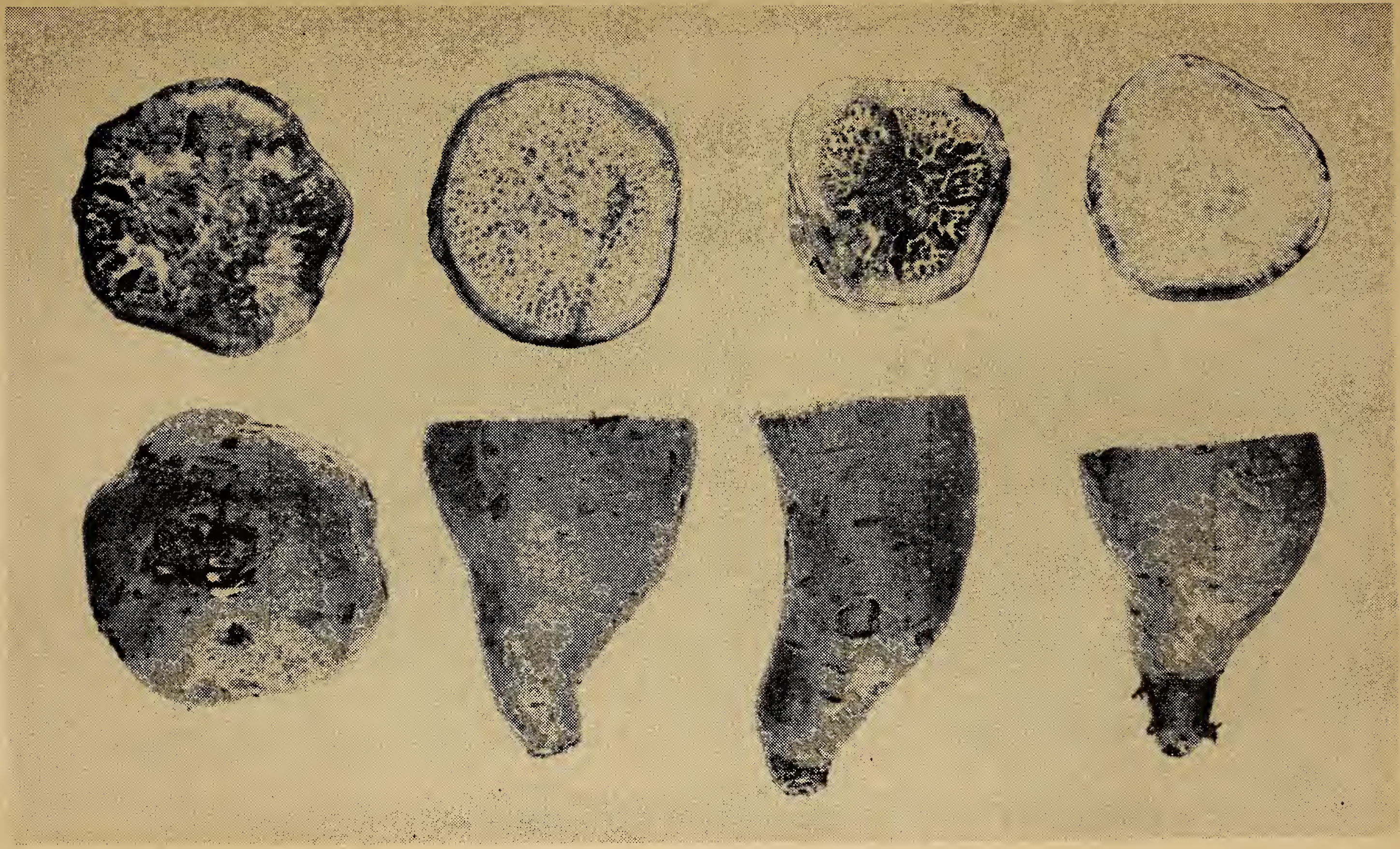

Figure 1. Left to right the potatoes were exposed to the following temperatures: 40° F. two weeks; 32° F. one week and then 40° F. one week; 34° F. one week and then 40° F. one week; check, not exposed to low temperature.

Pictures of the effect of cold injury to sweet potatoes are shown in Figures 1 and 2, taken March 20. Figure 1 shows a potato that was kept at 40° F. two weeks; one that was kept at 32° F. for one week then 40° F. for another; one that was kept at 34° F. for one week then 40° F. for a week; and a check potato which was not exposed to low temperature. The one that had been exposed to 34° F. then 40° F. is an excellent illustration of internal breakdown.

Figure 2 shows the fresh cut and day old cross section of a large check potato and one that had been exposed to 40° F. for one week. The potato that had been exposed to 40° F. shows internal cracks and the day old cut surface is not smooth.

Check potatoes and those that had been exposed to 40° F. were baked the first of April to test the effect of cold on flavor. The check potatoes

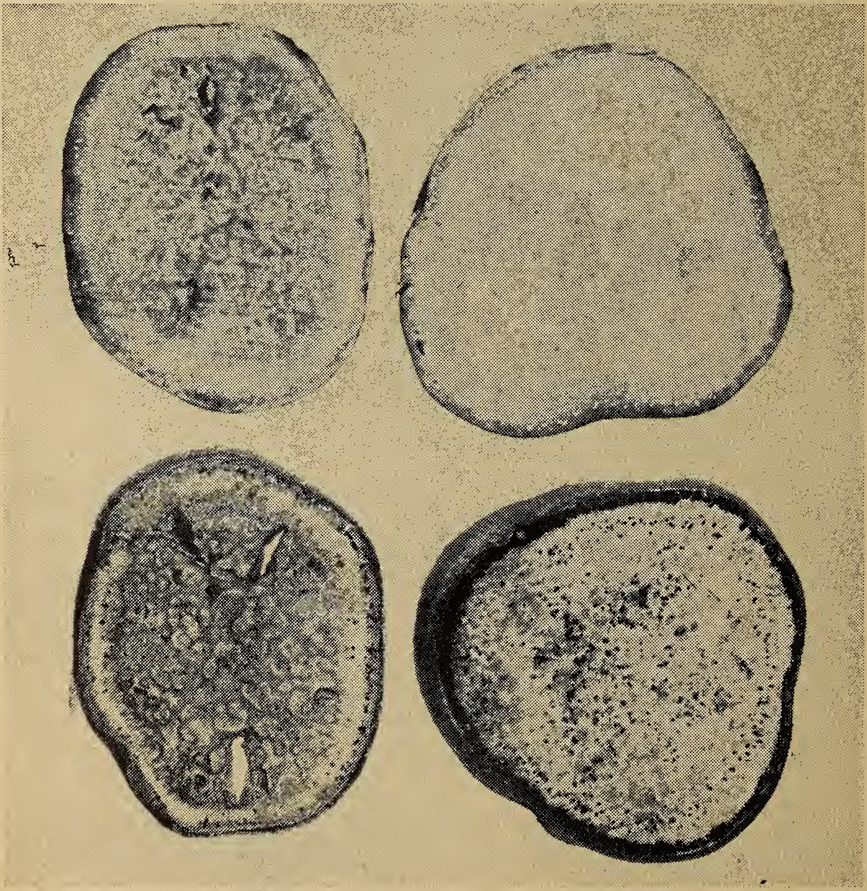

FIGURE 2. Potato on the left exposed to 40° F. for week—one on right not exposed to low temperature. Above, fresh cut surfaces; below, day old cut surfaces.

were excellent but the others had a bad flavor and had black streaks in them.

SUMMARY AND CONCLUSION

There seems to be no doubt that sweet potatoes are injured by exposures to temperatures above the freezing point. This injury may not be readily apparent until sometime after the period of exposure. In case of severe injury very little or no latex will be present on the cut surface of a potato and the cut surface does not look normal. After a lapse of time severe internal breakdown may be present in the potatoes.

Exposure to 40° F. for one week was injurious to the potatoes. The indications are that punkiness found in sweet potatoes late in the storage season might be, at least partly, due to slight exposure to cold.

The results obtained in this study indicate that the sweet potato is more easily injured by cold than has been realized in the past. Exposures that have apparently caused no damage may later prove to have been very injurious. This means that control of the minimum temperature of the storage is very important. The temperature in the houses should not be allowed to fall below 50° F. Arrangements for heating the house should be made and no chances taken on letting the temperature fall too low. In some winters in south Louisiana little or no heat may be necessary but in others the use of heat to prevent injury from cold may determine whether or not the potatoes will keep successfully.

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LOUISIANA BULLETIN NO. 355 NOVEMBER, 1942

The Use of Rice Polishings In Cooking

By

MARTHA E. HOLLINGER

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The Use of Rice Polishings* In Cooking

By

MARTHA E. HOLLINGER

INTRODUCTION

It has been recognized for many years that the by-products of rice (polishings and bran) are more nutritious than polished rice. Rice polishings contain from 2,250 to 5,000 International Units of vitamin B_1 (thiamin) per pound. The same amount of unfortified white flour contains approximately 335 International Units. The enriched flour that is now being marketed contains approximately 900 International Units of vitamin B_1 per pound. Rice polishings can be purchased from the rice mills at a much lower cost per pound than white flour. It has been found in the Nutrition Laboratories at Louisiana State University that 88 to 92 per cent of the thiamin value is retained after baking and practically none is lost in boiling. They are also a good source of the other vitamins of the B complex, with the possible exception of riboflavin. In addition they are a valuable source of minerals.

Rice polishings can be used in human foods as a natural and economical method of adding vitamin B_1 to the diet. They give a characteristic color and flavor to the products in which they are used. The flavor is very pleasing to many people, while others readily develop a taste for it. Rice polishings contain more fat and less gluten than white flour and consequently make tender products. Less fat should be used in doughs containing this product than in those made entirely with white flour. In some cases, as in griddle cakes and muffins, excellent results are obtained with no added fat. If the rice polishings have not been carefully sifted or "bolted" at the mill it is advisable to sift them through a fine sieve to remove broken grains of rice which do not become well cooked in baked products.

Rice polishings are ordinarily put up only in large bags for livestock feeding. However, many rice millers will be willing to supply the housewife with smaller quantities which they take directly from the mill, thus insuring freshness and cleanliness. Many grocery stores are now selling them in retail packages or will do so if there is sufficient demand in the community.

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* Rice polishings (or rice polish) are a by-product of rice obtained in the milling operation of brushing the grain to polish the kernel.

Rice polishings, like other cereal products which contain the outer coating of the grain, may become rancid or infested with insects if not properly stored or if kept for too long a time. For this reason, they should not be purchased in too large quantities and should be stored in a cool place, preferably in the refrigerator. This is especially true of the warmer months.

Rice is milled throughout the fall and winter months, and the polishings can be obtained fresh from the mill throughout a large part of the year.

The following recipes have been tested in the Nutrition Laboratories at Louisiana State University and have been widely used. They have been adapted from standard recipes. General purpose flour has been used in our testing. If too tender a product results when other flour is used, the fat in the recipe should be reduced. *All measurements are level.*

RECIPES INVOLVING THE USE OF RICE POLISHINGS

Biscuits

1 1/2 cups flour
1/2 cup sifted rice polishings
1/2 teaspoon salt
4 teaspoons baking powder
2 tablespoons fat
2/3 cup milk

Sift flour and rice polishings before measuring. Mix all dry ingredients. Cut fat in until there are no lumps larger than a pea. Add milk all at once. Stir until well blended. Knead slightly, roll, and cut. Bake in a hot oven (425° F.).

Corn Bread

1 1/2 cups corn meal
1/2 cup sifted rice polishings
3 teaspoons baking powder
3/4 teaspoon salt
1 egg
1 1/2 cups milk

Mix in the usual manner. Bake in hot oven until well browned and crusty. (425° F.).

Griddle Cakes

1 cup sifted rice polishings
1 cup flour
1 cup corn meal
1 tablespoon sugar
6 teaspoons baking powder
1 1/2 teaspoons salt
2 eggs
2 to 2 1/2 cups milk, depending on the thickness of griddle cake preferred.

Mix and bake in the usual manner.

Muffins

1 1/2 cups flour
1/2 cup sifted rice polishings
1/2 teaspoon salt
2 tablespoons sugar
4 teaspoons baking powder
2 eggs
2/3 cup milk

Mix together all dry ingredients. Beat eggs, add milk, and mix well. Pour this mixture into the dry ingredients, mix only until dry ingredients are well dampened. Pour into well greased muffin pans and bake in hot oven until they are well browned and spring back into shape when lightly touched with finger. Makes 12 large muffins.

Pie Crust

3/4 cup flour
1/4 cup sifted rice polishings
1/2 teaspoon salt
3 tablespoons fat
2 tablespoons water

Mix flour, rice polishings, and salt. Cut fat in until there are no lumps larger than a pea. Cut water in to form a very stiff dough. Roll thin. Bake in a hot oven (425° F.). Makes one large crust.

Crisp Tea Cakes

1/2 cup fat, preferably part butter
1 cup sugar
1 egg
2 tablespoons milk
1 1/2 teaspoons vanilla
1/2 teaspoon salt
1 1/2 cups flour
1 1/2 cups sifted rice polishings
1/2 teaspoon soda
3 teaspoons baking powder

Cream fat, add sugar, creaming together thoroughly. Add egg and milk and mix thoroughly. Mix dry ingredients thoroughly and add to the first mixture mixing to a stiff dough. Chill for an hour or more, roll thin, and bake in moderate oven until delicately browned.

Molasses Drop Cookies

1 1/2 cups cane syrup
1/2 cup melted shortening
1 egg
3 1/2 cups flour
1 cup sifted rice polishings
6 teaspoons baking powder
1/2 teaspoon salt
1/2 teaspoon ginger
1/2 teaspoon cinnamon

Mix in the usual manner. Drop by spoonfuls on a lightly greased baking sheet. Bake in a moderate oven (350° to 375° F.).

Chocolate Drop Cookies

1 cup sugar
1/2 cup fat
2 tablespoons milk
1/2 teaspoon vanilla
2/3 cup sifted rice polishings
1 1/3 cups flour
2 eggs
2 teaspoons baking powder
6 tablespoons cocoa
1/4 teaspoon salt
1 cup chopped nuts

Mix in the usual manner. Drop by spoonfuls on a baking sheet. Bake in a moderate oven (350° to 375° F.).

Spice Drop Cookies

1 cup sugar
1/2 cup fat
1/4 cup milk
2/3 cup sifted rice polishings
1 1/3 cups flour
1 egg
2 teaspoons baking powder
1 teaspoon ground nutmeg

Mix in the usual manner. Drop by spoonfuls on baking sheet. Bake in moderate oven (350° to 375° F.).

Ice Box Cookies

2/3 cup fat
1/3 cup water
1/3 cup brown sugar
1 egg
1/3 teaspoon salt
1 teaspoon cinnamon
3/4 cup flour
3/4 cup sifted rice polishings
1/3 teaspoon soda
1/2 cup pecans

Mix, roll in wax paper. Chill, slice thin, and bake in moderate oven (350° to 375° F.).

Rice Polishings Chocolate Pudding

2 squares chocolate or 6 tablespoons cocoa
2/3 cup sifted rice polishings
1/2 cup sugar
1/2 teaspoon salt
2 cups milk
2 eggs
1 teapsoon vanilla

Melt chocolate over water, add milk and heat. Mix sugar, rice polishings, and salt. Add this mixture to heated milk, stirring thoroughly. Cook in a double boiler or over a slow fire until well thickened. Pour slowly into the beaten eggs, return to sauce pan and cook two or three minutes longer. Add vanilla, cool, and serve.

Chocolate Milk

1/3 cup sifted rice polishings
3/4 cup sugar
1/2 cup cocoa
1/8 teaspoon salt
1 cup water

Mix dry ingredients thoroughly. Add water, and cook over hot water until thick. (The paste burns easily.) Cool the paste and add about two tablespoons to one cup of whole milk either cold or hot.

Butterscotch Milk

1/2 cup sifted rice polishings
3/4 cup brown sugar
1 cup water
1/8 teaspoon salt

Mix and cook to a thick paste using the double boiler. (The paste burns easily.)

For a cold drink: Fold 1 heaping tablespoon whipped cream, 2 tablespoons of paste, and 1 cup cold whole milk together.

For a hot drink: Heat 2 tablespoons of the paste in one cup of whole milk.

Waffles

1 cup flour
1/4 cup sifted rice polishings
1/2 teaspoon salt
1 tablespoon sugar
1 egg separated
1 cup sweet milk
2 tablespoons melted shortening

Sift dry ingredients. Beat egg yolk, add milk and melted shortening. Pour this mixture, all at once, into center of dry ingredients. Stir just until no dry flour can be seen. Fold in stiffly beaten egg whites. Bake in a well heated waffle iron. Yield: 3 large waffles.

Boston Brown Bread

1/4 cup white flour
1 teaspoon salt
1 teaspoon soda
1 egg well beaten
1 cup sweet milk
1 cup sour milk
1 cup molasses
1 cup corn meal
1 cup sifted rice polishings
1 cup whole wheat flour

Sift white flour, salt and soda. Add corn meal, whole wheat flour and rice polishings. Combine milk, egg and molasses. Turn into dry ingredients. Mix thoroughly. Turn into greased pans. Bake 45 minutes in moderate oven or steam 3 hours and bake 1/2 hour. Yield: 3 one-pound loaves.

Yeast Rolls

1 cake yeast
1/4 cup lukewarm water
1 cup scalded milk
2 tablespoons sugar
1 1/2 teaspoons salt
1 egg well beaten
1 cup rice polishings
2 1/2 to 3 cups flour

Soften yeast in lukewarm water. Pour hot milk over sugar and salt. Cool to lukewarm. Add softened yeast, beaten egg, rice polishings and enough flour to make a soft dough. Knead until smooth. Place in a greased bowl, grease top lightly and let rise until doubled in size. Shape into desired form, let rise until light and bake in a hot oven (400° F.). Yield: 18 rolls.

Raised Muffins

- 1 cup scalded milk
- 1 cup boiling water
- 2 tablespoons butter
- 1 cake yeast
- 1 egg well beaten
- 1/4 cup sugar
- 3/4 teaspoon salt
- 1/2 cup rice polishings
- 3 1/2 cups flour

Add butter, sugar and salt to milk and water. Cool to lukewarm, add yeast cake, egg and flour. Beat thoroughly. Let rise until light. Fill greased muffin pans half full. Let rise until pans are full. Bake 30 minutes in moderately hot oven (375° F.). The batter may be placed directly in the pans after mixing, thus saving the time required for the first rising. Yield: 2 dozen large muffins.

Molasses Spice Cake

- 1/2 cup cane syrup or molasses
- 3 tablespoons melted fat
- 1 egg
- 2 tablespoons water
- 1 cup wheat flour
- 1/4 cup sifted rice polishings
- 1/4 teaspoon soda
- 1 teaspoon baking powder
- 1/4 teaspoon salt
- 1/4 teaspoon cinnamon
- 1/4 teaspoon allspice
- 1/4 teaspoon nutmeg

Add melted fat to syrup or molasses. Add beaten egg and water. Mix flour, rice polishings and spices. Add this dry mixture to liquid ingredients and mix well. Add baking powder and soda and stir just enough to mix. Bake in a moderate oven (360° F.). Serves 6 to 8.

Other Ways of Using Rice Polishings

The housewife who wishes to do so can find many other ways to incorporate this valuable and inexpensive food in the family diet. They may be added to meat for meat loaf or hamburger in the proportion of one cup of rice polishings to one pound of ground meat. They may be used for thickening in soups and stews and for coating fish or steak before frying. Reports have been received of their use as a thickening agent in ice creams in place of a refined starch and of adding small amounts to boiled rice before cooking. They may be added in this manner to any cooked cereal.

LOUISIANA BULLETIN NO. 356 DECEMBER, 1942

A STUDY OF THE DIETS OF HOME DEMONSTRATION CLUB MEMBERS' FAMILIES IN TWENTY-SEVEN PARISHES OF LOUISIANA

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INTRODUCTION*

At the present time, human nutrition is receiving much attention throughout the nation as shown by an increased amount of research, conferences and the organization of national, state and parish committees to work on nutritional problems.

Reports from the Louisiana Selective Service boards, the State Department of Health and research by the Louisiana Agricultural Experiment Station reveal faulty dietary habits. However, there has been no definite information available as to the adequacy of diets of Home Demonstration Club members' families in Louisiana. These families represent a large percentage of the rural population of the state.

This bulletin reports a study of the diets of 780 Home Demonstration Club members' families in 27 parishes of Louisiana. The relationship between the adequacy of the diets and agricultural areas, farm tenure, income, home-produced foods, and the preservation of fruits and vegetables has been included.

METHODS OF SECURING DATA

In order to obtain the desired information concerning the diets of these families, a two-page questionnaire was prepared, which when properly filled out showed the foods served at each meal for a one week period. These records reveal interesting data concerning the food habits of this group of families living in rural areas and small towns of Louisiana.

In March, 1942, the State Home Demonstration agent asked parish home demonstration agents throughout the state to volunteer to take part in this project. Twenty-seven parish agents agreed to cooperate. The questionnaires were explained thoroughly at local home demonstration club meetings, and the forms were collected after they had been filled out.

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* The data for this study were secured by the cooperation of Miss Ellen LeNoir, State Home Demonstration agent, and 27 parish home agents.

Five thousand questionnaires were given to club members, and 956 were returned. The incomplete forms were discarded, leaving a total of 780. A form was not considered complete unless foods served at each meal were listed for each of the seven-day period.

In evaluating the diets a score card was developed which was patterned after the so-called National Nutritional "yardstick" or dietary "pattern." This "yardstick" was established by the Food and Nutrition committee of the National Research council at the Nutritional conference held in Washington, D. C., May 26-28, 1941. The Food and Nutrition committee was composed of 28 authorities in the field of food and nutrition.

The score card classed all protective foods either as good, fair or poor, depending upon the number of servings, during a one-week period as shown in Figure 1.

FIGURE 1. THE SCORE CARD FOR DETERMINING THE ADEQUACY OF DIETS OF THE 780 HOME DEMONSTRATION CLUB MEMBERS' FAMILIES.

	SERVINGS PER WEEK		
	Good	Fair	Poor
Milk	14 or more	8–13	7 or less
Butter	14 " "	8–13	7 " "
Eggs	5 " "	3– 4	2 " "
Lean meat or substitute*	7 " "	4– 6	3 " "
Vegetables			
Green, leafy, or yellow	7 " "	4– 6	3 " "
Others	7 " "	4– 6	3 " "
Potatoes	7 " "	4– 6	3 " "
Whole grain cereals	10 " "	5– 9	4 " "
Fruits, tomatoes, or raw vegetables			
Citrus or tomatoes	7 " "	4– 6	3 " "
Other fruits or raw vegetables†	7 " "	4– 6	3 " "

*Lean meat as such must appear in the menu at least four times per week.

†The only raw vegetables included in this group were cabbage, green peppers, and radishes.

In applying the score card, each of the 10 foods or food groups was scored either as good, fair or poor. A diet that measured up to the recommendation of the "yardstick" obviously scored good in all respects. If a food was served only one-half as many times during the week as is recommended in the "yardstick" it was classed as poor. Foods that were served more than one-half, but less than the recommended number of servings were classed as fair (Figure 1).

After classifying the foods individually, the total diet was classed either as good, fair or poor. Diets which included 80 or more servings of protective foods per week were classed as good; those including 48 to 79 servings of protective foods per week were classed as fair, and the diets that included 47 or less servings of protective foods per week were classed as poor. After scoring numerous diets and calculating their composition in terms of food nutrients (protein, vitamins, minerals, etc.) it was found that this method of evaluation was satisfactory. In classifying diets according to this system, a good diet may be defined as one which was adequate in all known respects. A poor diet was distinctly deficient in one or more of the food factors necessary for optimum health. Diets that were classified as fair were defined as borderline diets. It was assured that an active individual who was eating a "fair" diet did not receive enough of the various food factors to meet adequately his requirements.

The score card used in determining the adequacy of the quantity of fruits and vegetables canned at home was based upon the food preservation budget recommended by the Louisiana Agricultural Extension service. The recommended number of quarts of canned fruits and vegetables per person per year was taken as a standard. Families preserving 100 per cent, or more, of the recommended quantity were classified as good; those preserving 66 to 99 per cent of the recommended quantity were classified as fair; and those preserving 65 per cent, or less, of the recommended quantity were classified as poor. The score card used in evaluating home canned fruits and vegetables is shown in Figure 2.

FIGURE 2. Score Card for Evaluating Home Canned Fruits and Vegetables

	Quarts Per Person Per Year		
Products	*Good*	*Fair*	*Poor*
Canned Fruits	34 or more	23 - 33	22 or less
Canned Vegetables	46 or more	31 - 45	30 or less

For agriculture purposes Louisiana has been divided into seven distinct Agricultural Areas as shown in Figure 3. It seems logical to expect the diets of farm families to vary somewhat according to the prevailing type of agriculture; therefore, in conducting these studies all summaries and comparisons were made on Agricultural Area basis.

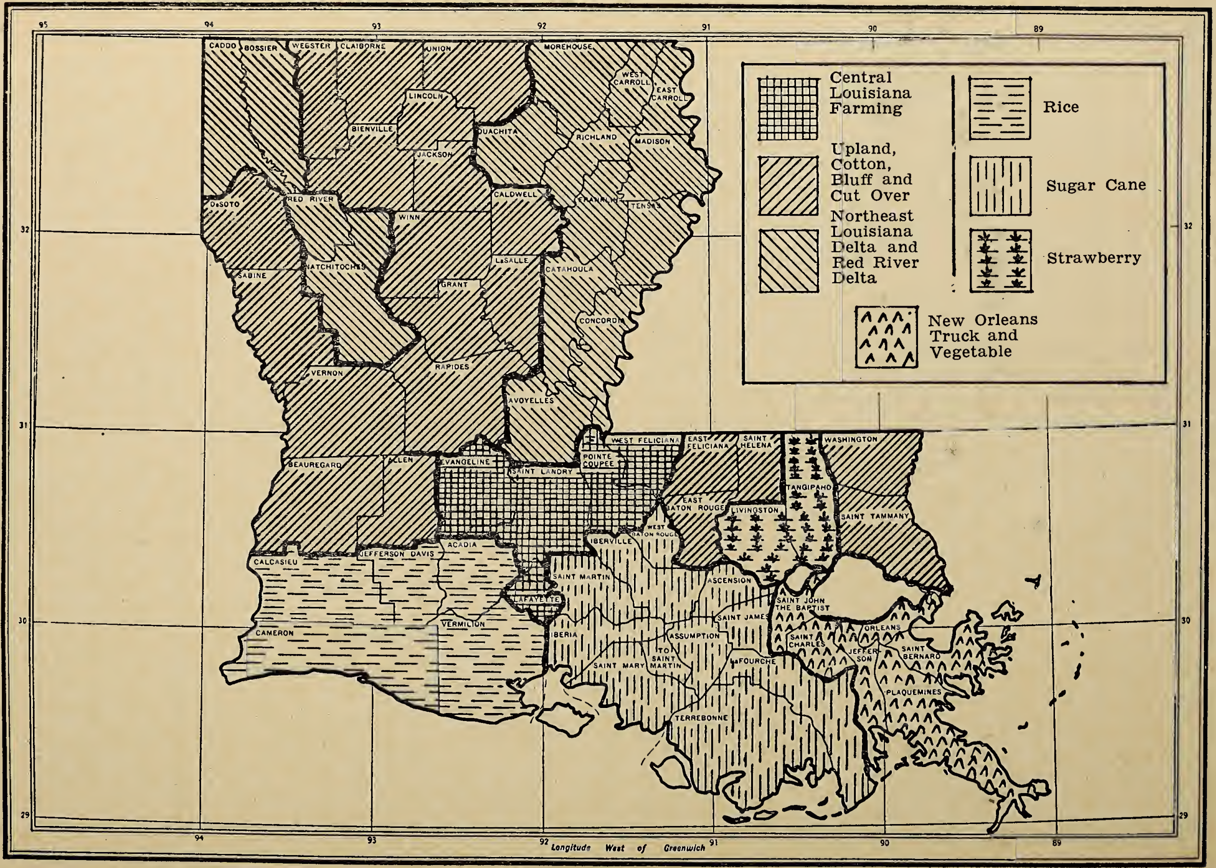
The 27 parishes which participated in this study are shown in Table 2. Only five of the seven agricultural areas were represented. The areas not represented were the New Orleans truck and vegetable area and the Central Louisiana farming area.

Results and Discussion

A summary of the analysis of the families' diets from the 27 parishes included in this study shows that 41 per cent scored good, 51 per cent scored fair and 8 per cent scored poor. (Table 1).

The adequacy of the diets in the different agricultural areas varied considerably. In the rice area 53 per cent of the diets studied were found to be good, 40 per cent were fair, and 7 per cent were poor; in the straw-

FIGURE 3. AGRICULTURAL AREAS IN LOUISIANA



berry area, 37 per cent were good; 54 per cent fair, and 9 per cent poor; in the sugar cane area, 8 per cent were good, 65 per cent fair, and 27 per cent poor; in the northeast Louisiana delta and Red River delta area, 44 per cent were good, 48 per cent fair, and 8 per cent poor; and in the upland cotton, bluff and cut-over land area, 39 per cent were good, 55 per cent fair, and 6 per cent poor. There were fewer families reporting from the strawberry and sugar cane areas than from the other areas studied as shown in Table 1.

All of the parishes included in this study reported diets that were classed as good; they varied slightly in proportion to the fair and poor diets, as shown in Table 2. One parish Ouachita, reported no diets that were classed as poor. Three parishes, Cameron, Caldwell and LaSalle, each revealed records with no poor diets. In each of these parishes, however, very few families reported the foods served to their families. The diets classed as fair represented one-third or more of the diets in each of the parishes studied.

TABLE 1. Standard of Diets of Home Demonstration Club Members' Families in Louisiana, by Agricultural Areas.

Areas	Diets in Each Standard						Total Families Reporting
	Good		Fair		Poor		
	Number	Per Cent	Number	Per Cent	Number	Per Cent	
Rice	73	53	55	40	9	7	137
Strawberry	13	37	19	54	3	9	35
Sugar Cane	4	8	31	65	13	27	48
Northeast Louisiana Delta and Red River Delta	117	44	125	48	21	8	263
Upland Cotton, Bluff, and Cut-Over Land	115	39	164	55	18	6	297
Total	322	41	394	51	64	8	780

Adequacy of the Diets in the Ten Protective Foods or Food Groups

A summary of the findings resulting from a study of the data showing the foods served by these families is discussed. Some of the findings are presented graphically in Chart 1.

In the classification of the 10 protective foods or food groups, lean meat and meat substitutes scored good in the areas studied more frequently than any other food group; eggs ranked second; milk, third; green, leafy and yellow vegetables, fourth; other cooked vegetables, fifth; fruits and certain raw vegetables, sixth; citrus fruits and tomatoes, seventh; butter, eighth; potatoes, ninth; and whole grain cereals, tenth.

TABLE 2. STANDARD OF DIETS OF HOME DEMONSTRATION CLUB MEMBERS' FAMILIES BY PARISHES, IN THE FIVE AREAS IN LOUISIANA

AREAS AND PARISHES	NUMBER OF FAMILY DIETS IN EACH STANDARD						Total Families Reporting
	GOOD		FAIR		POOR		
	Number	Per Cent	Number	Per Cent	Number	Per Cent	
RICE:							
Acadia	48	57	33	39	3	4	84
Calcasieu	12	57	7	33	2	10	21
Cameron*	3	43	4	57	. .	. .	7
Jefferson Davis*	5	83	. .	. .	1	17	6
Vermilion*	5	26	11	58	3	16	19
TOTAL	73	53	55	40	9	7	137
STRAWBERRY:							
Livingston	13	37	19	54	3	9	35
TOTAL	13	37	19	54	3	9	35
SUGAR CANE:							
Iberville*	3	37.5	3	37.5	2	25	8
St. Martin	1	2.5	28	70	11	27.5	40
TOTAL	4	8	31	65	13	27	48
NORTHEAST LOUISIANA DELTA AND RED RIVER DELTA:							
Catahoula	10	22	28	61	8	17	46
Concordia*	5	56	3	33	1	11	9
East Carroll	25	50	23	46	2	4	50
Madison	17	55	11	35	3	10	31
Morehouse	9	43	11	52	1	5	21
Ouachita	28	68	13	32	. .	. .	41
Richland	10	44	12	52	1	4	23
Tensas	5	22	15	65	3	13	23
West Carroll*	8	42	9	47	2	11	19
TOTAL	117	44	125	48	21	8	263
UPLAND COTTON, BLUFF AND CUT-OVER LAND:							
Beauregard	6	23	17	65	3	12	26
Bienville	14	32	28	64	2	4	44
Caldwell*	2	50	2	50	. .	. .	4
DeStoto	11	55	8	40	1	5	20
Grant	14	37	23	60	1	3	38
Jackson	6	30	12	60	2	10	20
La Salle*	6	40	9	60	. .	. .	15
Lincoln	23	40	32	55	3	5	58
Union	13	46	12	43	3	11	28
Vernon	20	45	21	48	3	7	44
TOTAL	115	39	164	55	18	6	297
GRAND TOTAL	322	41	394	51	64	8	780

*These families had less than 20 families reporting and therefore may not present a true sample of the diets in those parishes. They were used in order to make a more complete record for the areas.

Milk. Seventy-one per cent of the diets in this study scored good in milk consumption. More than one-half of them were classified as good for the total diet, while most of the others scoring good in milk consumption fell in the group that scored fair for the total diet.

Milk consumption in the five areas was approximately the same, with the rice area slightly highest and the sugar cane area lowest. In all areas, as milk consumption increased there was a similar increase in the percentage of diets that scored good.

Butter. Forty-seven per cent of the 780 diets studied scored good in butter consumption. About two-thirds of them also scored good for the total diet. Slightly more than one-third of the diets classified as good in the use of this food scored fair for the total diets.

The upland cotton, bluff and cut-over area consumed slightly more butter per family than any other area in the state, with the northeast Louisiana delta and Red River delta area ranking second. The rice and strawberry areas were next, while in the sugar cane area only one-tenth of the diets studied scored good in butter consumption.

Eggs. Seventy-two per cent of the diets studied were classified as good in egg consumption. The season of the year when this study was made probably influenced the number of eggs consumed. Had the study been made during the late summer, autumn or winter months when egg production is usually lower, a different picture might have been obtained. About one-half of the diets classified as good in egg consumption also scored good for the total diet, while most of the remaining diets that ranked high in the consumption of this food scored fair for the total diet. Egg consumption was considerably lower in the sugar cane area than in the other areas.

Lean Meat and Meat Substitutes. Eighty per cent of all the diets studied were classified as good in the consumption of lean meat and meat substitutes. Lean meat, as such, had to appear in the diet at least four times per week in order for the diet to score good. The remainder of the seven (or more) servings may have been chosen from foods such as cheese, dried beans, dried peas or soybeans. About one-half of the 625 diets which scored good in the consumption of this food group also scored good in total diets, and approximately the same number scored fair for the total diets. Only four per cent of the diets scoring good in meat consumption were classed as poor for the total diet.

Meat appeared more frequently in the diets of families living in the rice area than in any other area. In fact, 89 per cent of all the diets within this area scored good in the consumption of this food group. The strawberry area ranked second; the upland cotton, bluff and cut-over land area ranked third; the northeast Louisiana delta and Red River delta area fourth; and the sugar cane area, fifth. In all areas practically all the diets classified as good were found to score high in meat consumption. There was a definite trend toward poor total diets where meat consumption was low.

Green, Leafy and Yellow Vegetables. Sixty-six per cent of the diets studied scored good in the consumption of green, leafy and yellow vegetables. More than one-half of these diets scored good for the total diet and approximately one-half scored fair. Six diets that were rated good in the use of these vegetables scored poor for the total diet.

The rice area rated much higher in the consumption of green, leafy and yellow vegetables than the other areas, and the sugar cane area ranked lowest. The other three areas consumed approximately the same quantity of these foods.

Other Cooked Vegetables. The consumption of other cooked vegetables, including peas, butterbeans, beets, onions, okra, turnip bottoms and other varieties not included in the green, leafy and yellow vegetables group, was found to be lower than that for the state as a whole. Fifty-nine per cent of the diets were rated as good in the consumption of other cooked vegetables; 23 per cent were rated fair; and 18 per cent were rated poor.

There were slight variations in the consumption of these vegetables in the different areas. The diets in the rice area scored highest (65 per cent good) in the use of these vegetables while the strawberry area ranked lowest with only 40 per cent of the diets scoring good in this respect. In each area there was a trend toward poor total diets where the use of these vegetables was low.

Potatoes. Forty-six per cent of the diets studied were classified as good in the consumption of potatoes, 29 per cent were fair, and 25 per cent were poor. Of the total number of diets classified as good in the state about two-thirds rated good in the use of potatoes; slightly more than one-fourth rated fair; and about one-tenth rated poor.

The rice area ranked highest in the use of potatoes and the sugar cane area ranked lowest; there was very little variation among the other areas. It is quite probable that the season of the year influenced the amounts of potatoes consumed. If these records had been collected during the fall or winter, the consumption of potatoes might have been greater.

Whole Grain Cereals. The consumption of whole grain cereals was found to be lowest of any of the protective food groups, with 14 per cent of the diets scoring good, 34 per cent fair and 52 per cent poor.

The rice area had twice as many diets (26 per cent) scoring good in the use of whole grain cereals as the northeast Louisiana delta and Red River delta area. The other three areas ranked even lower in the use of these foods. Since the diets throughout the state ranked relatively low in the use of whole grain cereals, there is a strong possibility that many of the diets are deficient in thiamin (vitamin B_1).

Citrus Fruits and Tomatoes. Fifty per cent of the diets studied scored good in the use of citrus fruits and tomatoes; 23 per cent scored fair; and

27 per cent scored poor. Slightly more than three-fourths of the diets scoring good in this food group also scored good in total diets. The majority of the diets scoring fair in the consumption of citrus fruits and tomatoes were found to score fair for the total diet. Four-fifths of the total diets classified as poor in the state also rated poor in the consumption of these foods.

A larger per cent of the diets (63 per cent) scored good in the consumption of citrus fruits and tomatoes in the rice area than in the other areas. The percentages for the northeast Louisiana delta and Red River delta and the upland cotton, bluff and cut-over areas were next with 51 and 50 per cent respectively. A decline was found in the use of these foods in the other two areas, with only 36 per cent scoring good in the sugar cane area and 34 per cent scoring good in the strawberry area.

Other Fruits and Certain Raw Vegetables. Other fruits and certain raw vegetables included all fruits other than citrus and raw cabbage, green peppers and radishes. Taking the state as a whole the consumption of these foods was considerably higher than for citrus fruits and tomatoes. Fifty-five per cent of the total diets scored good in the use of these foods, 24 per cent scored fair and 21 per cent scored poor.

A wide variation existed in two of the agricultural areas in the use of these foods. In the rice area 64 per cent of the diets scored good whereas in the sugar cane area only 25 per cent scored good. In the remaining three areas 51 to 60 per cent of the diets scored good.

CONSUMPTION OF NON-PROTECTIVE FOODS AS RELATED TO TOTAL DIETS

The non-protective foods referred to in this study include fat meats, refined starchy foods and sweets. These food groups were found to be served more frequently in the good than in the fair diets, and more frequently in the fair than in the poor diets. Apparently these foods did not replace the essential food groups but seemed to supplement the servings of protective foods used by the families.

FOOD PRODUCTION AND CONSERVATION AS RELATED TO THE DIET STANDARD

Milk Cows. This survey showed an average of 2.2 milk cows per family. When correlated with the adequacy of milk in the diet, the average number of milk cows per family increased as the standard for milk and the adequacy of the diets increased (Table 3).

The 551 families which were classified as good in milk consumption owned an average of 3.2 milk cows per family; the 94 families classified as fair in milk consumption owned an average of 2 cows per family; and the 135 families classified as poor owned an average of 1.4 milk cows per family.

Families in the rice area owned a larger number of milk cows per family than the families in the other areas, and the per cent of diets classi-

FIGURE 4. Distr

■ GOOD

▨ FAIR

▩ POOR

THE PROPORTION OF
IN THE THREE CLA

RESULTS OF A STUDY OF 780 HOME
IN THE FIVE FARMING ARE

SELECTED FOODS	RICE AREA			STRAWBERRY ARE		
	■	▨	▩	■	▨	▩
MILK	96 3 1	56 4 40	45 3 22	100	63 16 21	 100
BUTTER	60 7 33	20 7 73	 10 90	69 31	26 74	 33
EGGS	82 14 4	60 35 5	44 11 44	77 23	68 16 16	 33
LEAN MEATS AND MEAT SUBSTITUTES	95 5	87 11 2	56 10 34	100	74 26	 3
GREEN LEAFY AND YELLOW VEGETABLES	92 7 1	76 20 4	33 22 45	92 8	58 21 21	 10
OTHER COOKED VEGETABLES	84 12 4	47 42 11	22 78	85 15	16 37 47	 10
POTATOES	57 33 10	58 22 20	 67 33	54 46	47 37 16	33 34 3
WHOLE GRAIN CERALS	38 45 17	13 16 71	 10 90	8 54 38	11 21 68	 10
CITRUS FRUITS AND TOMATOES	83 10 7	42 24 34	22 10 67	69 23 8	16 31 53	 33
OTHER FRUITS AND CERTAIN RAW VEGETABLES	90 7 3	36 46 18	22 78	85 15	47 37 16	 10

*The distribution of the foods ir

ELECTED FOODS
ES OF DIETS *

780 FAMILIES REPORTING

ONSTRATION FAMILIES LIVING
F LOUISIANA

SUGAR CANE AREA			N.E. LA. & RED RIVER DELTA AREA			UPLAND COTTON BLUFF & CUT-OVER LAND		
■	▨	▩	■	▨	▩	■	▨	▩
100	51 39 10	69 16 15	92 5 3	58 17 25	33 14 53	86 10 4	64 15 21	11 17 72
50 50	10 13 77	15 85	74 16 10	38 16 46	10 10 80	77 15 8	41 19 40	11 11 78
75 25	54 23 23	8 38 54	90 8 2	72 21 7	48 33 19	87 10 3	65 27 8	56 22 22
100	81 16 3	54 23 23	96 2 2	67 18 15	14 19 67	94 6	75 10 15	39 22 39
100	45 36 19	8 23 69	86 11 3	50 23 27	5 95	85 12 3	60 22 18	5 28 67
75 25	58 26 16	46 54	82 12 6	50 29 21	24 38 38	82 13 5	47 30 23	6 28 66
50 50	13 29 58	8 15 77	70 21 9	35 26 39	14 24 62	58 31 11	37 35 28	33 6 61
75 25	7 23 70	100	26 40 34	2 29 69	19 81	21 55 24	8 30 62	11 89
75 25	45 39 16	15 85	75 19 6	34 38 28	19 81	75 20 5	32 25 43	6 6 88
50 50	29 29 42	8 92	81 14 5	29 39 32	10 19 71	82 16 2	49 27 24	11 28 61

of the diets is expressed in percentages.

fied as good in milk consumption (Table 3) was higher than in other areas. The sugar cane area had the lowest per cent of good diets in the use of milk and the lowest average number of milk cows per family. The other three areas showed the same per cent of good diets in servings of milk, but the strawberry area had a slightly lower average of cows than the northeast Louisiana delta and Red River delta or the upland cotton, bluff, and cut-over land areas.

TABLE 3. RELATIONSHIP OF COWS OWNED TO STANDARD FOR MILK WITHIN THE FIVE AREAS

AREA	GOOD		FAIR		POOR	
	Number of Diets	Ave. No of Cows per family	Number of Diets	Ave. No. ot Cows per family	Number of Diets	Ave. No. of Cows per family
Rice	105	5.2	7	2.7	25	1.5
Strawberry	25	2.0	3	1.3	7	1.3
Sugar Cane	29	2.4	14	1.3	5	0.4
Northeast Louisiana Delta and Red River Delta	187	3.2	31	1.9	45	1.9
Upland Cotton, Bluff, and Cut-Over Land	205	3.3	39	2.6	53	1.8
TOTAL	551	...	94	...	135	...
Average for the Combined Areas	...	3.2	..	2.0	...	1.4

Lean Meat Consumption. (1) Hens. The families included in this study owned an average of 31.8 hens per family. When correlated with the use of lean meat in the diet, the average number of hens increased as the standard for lean meat increased. Six hundred and twenty-five families classified as good in consumption of lean meat owned an average of 39.6 hens per family; 80 families classified as fair owned an average of 33.7 hens; and 75 families classified as poor owned an average of 22 hens per family.

A larger number of hens (44.6) per family was owned by the group living in the rice area than in any other area (Table 4). Northeast Louisiana delta and Red River delta area families owned an average of 33.8 hens per family; the families of the upland cotton, bluff and cut-over area, 31.8 hens; the families of the sugar cane area, 25.7 hens; and the families of the strawberry area, 22.5 hens per family.

(2) Brood Sows. All the families included in this study owned an average of 1.19 brood sows per family (Table 4). When correlated with the adequacy of lean meat in the diet, the average number of brood sows increased as the use of lean meat increased except in the case of one family classified as poor in the strawberry area. This family reported the ownership of four brood sows. (However, the same family reported

a lower ownership of hens than was found in any other area, and they did not slaughter any beef animals). This high ownership of brood sows did not raise their standard for lean meat consumption, since the family was classified as poor in the use of this food group.

TABLE 4. STANDARD FOR LEAN MEAT AND MEAT SUBSTITUTES IN RELATION TO HENS AND BROOD SOWS OWNED AND BEEVES SLAUGHTERED WITHIN THE FIVE AREAS.

AREA AND STANDARD FOR LEAN MEAT	AVERAGE NUMBER PER FAMILY			Total Families Reporting
	Hens	Brood Sows	Beeves Slaughtered	
RICE:				
Good	59.4	0.64	0.48	122
Fair	40.5	1.63	0.90	11
Poor	33.8	0.25	0.25	4
AVERAGE	44.6	0.84	0.54	....
STRAWBERRY:				
Good	28.4	0.72	0.03	29
Fair	30.0	0.20	0.00	5
Poor	9.0	4.00	0.00	1
AVERAGE	22.5	1.64	0.01	....
SUGAR CANE:				
Good	40.5	1.38	0.22	36
Fair	24.5	0.50	0.37	8
Poor	12.0	0.50	0.00	4
AVERAGE	25.7	0.79	0.30	....
NORTHEAST LOUISIANA DELTA AND RED RIVER DELTA:				
Good	36.1	1.83	0.30	200
Fair	34.1	1.93	0.21	29
Poor	31.3	1.50	0.21	34
AVERAGE	33.8	1.75	0.24	....
UPLAND COTTON, BLUFF AND CUT-OVER LAND:				
Good	33.7	1.08	0.27	238
Fair	39.3	0.74	0.18	27
Poor	24.0	1.03	0.15	32
AVERAGE	32.3	0.95	0.20	....
AVERAGE FOR COMBINED AREAS	31.8	1.19	0.24	....

The families in the northeast Louisiana delta and Red River delta area owned a larger number of brood sows per family (1.74) than in any other area studied. The families in the strawberry area owned 1.64 brood sows per family; the families in the upland cotton, bluff and cut-over land area owned an average of 0.95 brood sows; the families in the rice area, 0.84 brood sows; and the families in the sugar cane area owned 0.79 brood sows per family.

(3) Beeves slaughtered. The average number of beeves slaughtered by families in this study was 0.24 per family (Table 4). A larger average number was slaughtered by the families classified as fair in lean meat consumption than by those classified as good. However, those classified as poor in lean meat consumption reported a lower number of beeves slaughtered than the families classified as good or fair.

The families in the rice area slaughtered an average of 0.54 beeves per family; the sugar cane area, 0.30 beeves per family; the northeast Louisiana delta and Red River delta area, 0.24 per family; the upland cotton, bluff and cut-over land area, 0.20 per family; and the families in the strawberry area reported an average of .01 beeves slaughtered per family.

No information was given on the amount of beef purchased. However, as 80 per cent of the diets met requirements for lean meat consumption and an average of 1.61 beeves per family was marketed, this indicates that in some instances families sold and purchased beef as it was needed.

Canned Fruits. Fewer families met the requirements for canned fruits than for canned vegetables except in the rice area (Tables 5 and 6). The northeast Louisiana delta and Red River delta and the upland cotton, bluff and cut-over land areas led in the canning of fruits. The rice area ranked third; the strawberry area fourth; and the sugar cane area fifth. Only 19 per cent of the families in all areas scored good in the amount of fruit canned, 15 per cent scored fair, and 66 per cent scored poor.

TABLE 5. STANDARD FOR CANNED FRUIT WITHIN THE FIVE AREAS.

AREAS	STANDARD FOR FRUIT						Total Families Reporting
	GOOD		FAIR		POOR		
	Number	Per Cent	Number	Per Cent	Number	Per Cent	
Rice	21	16	28	21	85	63	134
Strawberry	4	11	7	20	24	69	35
Sugar Cane	3	6	..	..	45	94	48
Northeast Louisiana Delta and Red River Delta	57	22	43	16	162	62	262
Upland Cotton, Bluff and Cut-Over Land	62	21	41	14	192	65	294
TOTAL	147	..	118	..	508	..	773
Average for Combined Areas	..	19	..	15	..	66	...

Canned Vegetables. Home canning of vegetables followed the same trends as the daily consumption of vegetables, except in the rice area (Table 6). Twenty-five per cent of the families met requirements for canned vegetables, 14 per cent were classified as fair and 61 per cent poor.

There was a wide variation among the five areas as to the quantity of vegetables canned. In general, the areas in North Louisiana canned considerably more vegetables than South Louisiana areas. The rice area ranked lower than any other in the quantity of vegetables canned, yet it ranked highest in the daily consumption of vegetables. This indicates that farmers in the rice area give more attention to growing of home gardens throughout the year than farmers in other areas.

TABLE 6. STANDARD FOR CANNED VEGETABLES WITHIN THE FIVE AREAS.

AREAS	STANDARD FOR VEGETABLES						Total Families Reporting
	GOOD		FAIR		POOR		
	Number	Per Cent	Number	Per Cent	Number	Per Cent	
Rice	14	10	10	8	110	82	134
Strawberry	5	14	4	12	26	74	35
Sugar Cane	5	11	3	6	40	83	48
Northeast Louisiana Delta and Red River Delta	90	35	48	18	124	47	262
Upland Cotton, Bluff and Cut-Over Land	80	27	44	15	170	58	294
TOTAL	194	..	109	..	470	..	773
AVERAGE FOR COMBINED AREAS	..	25	..	14	..	61	...

Vegetable Production and Preservation. The average number of vegetables per family used from gardens, the average number per family that had been recently planted and the average number of quarts canned last year per person increased as the adequacy of diets increased (Table 7). Families whose diets were classified as good showed that an average of 3.9 vegetables were used from the gardens during the month of March, an average of 8.6 vegetables previously planted for future use, and an average of 31.9 quarts of canned vegetables per person. The families whose diets were classified as fair or poor had fewer vegetables supplied by the gardens, fewer planted for future use, and preserved a smaller quantity of vegetables per person.

More differences existed in the five areas regarding vegetables used from the garden than with those planted for future use. The areas in North Louisiana reported fewer vegetables used from the garden at this particular time of the year (March) than from the areas in South Louisiana. This probably was due to differences in the climatic conditions in North and South Louisiana. The North Louisiana areas reported an average of about two more vegetables planted for future use and showed an average of approximately twice as many quarts of vegetables canned per person than was reported from the areas in South Louisiana.

TABLE 7. VEGETABLE PRODUCTION AND PRESERVATION IN RELATION TO THE TOTAL DIET STANDARD WITHIN THE FIVE AREAS.

AREAS AND TOTAL DIET STANDARD	AVERAGE NUMBER PER FAMILY		Average Quarts of Vegetables Canned Per Person	Total Families Reporting
	Vegetables Now Eating	Vegetables Recently Planted		
RICE:				
Good	4.29	7.79	17.47	73
Fair	3.83	7.31	17.49	55
Poor	3.77	5.56	21.66	9
AVERAGE	3.96	6.89	18.87	..
STRAWBERRY:				
Good	3.31	9.84	30.54	13
Fair	2.11	7.21	26.05	19
Poor	3.00	5.67	12.00	3
AVERAGE	2.81	7.57	22.86	..
SUGAR CANE:				
Good	6.50	7.50	34.00	4
Fair	5.06	6.87	16.22	31
Poor	5.31	5.77	6.08	13
AVERAGE	5.62	6.71	18.77	..
NORTHEAST LOUISIANA DELTA AND RED RIVER DELTA:				
Good	2.66	8.56	41.58	117
Fair	2.46	7.76	36.71	125
Poor	1.19	7.80	33.05	21
AVERAGE	2.10	8.04	37.11	..
UPLAND COTTON, BLUFF AND CUT-OVER LAND:				
Good	2.94	9.25	35.65	115
Fair	2.23	7.99	28.94	164
Poor	1.67	7.56	33.44	18
AVERAGE	2.28	8.27	32.68	..
AVERAGE FOR COMBINED AREAS	3.36	7.50	26.06	..

ADEQUACY OF THE DIETS AS RELATED TO ECONOMIC AND OTHER FACTORS

Income. The adequacy of diets increased as the cash income of families rose to a higher level in all income classes except one. There was a slightly higher percentage of good diets in the income class of $300-$499 than in the income class of $500-$749 (Table 8). More than one-fourth of the families reported incomes of $299 or less per year, slightly less than one-fourth of the families reported incomes between $300-$499, and the four higher income classes included less than one-twelfth of the families in each class. In fact, approximately one-half of the total families were found to come within the two lowest income classes.

Tenure of Operation. In classifying owners and tenants in relation to the diet standard, there was a consistent trend of more adequate diets for the owners than for the tenants (Table 9). Of the 476 families classified as owners, 45 per cent were found to have good diets; 49 per cent had fair diets; and 6 per cent had poor diets. Thirty-one per cent of the 214 tenant families had good diets, 54 per cent had fair diets, and 15 per cent had poor diets.

TABLE 8. TOTAL DIET STANDARD IN RELATION TO INCOME

INCOME CLASS	DIET STANDARD						Total Families Reporting
	GOOD		FAIR		POOR		
	Number	Per Cent	Number	Per Cent	Number	Per Cent	
$ 0– 299	66	30	125	56	31	14	222
300– 499	60	36	92	56	13	8	165
500– 749	22	33	41	60	5	7	68
750– 999	35	59	20	34	4	7	59
1,000–1,499	28	61	17	37	1	2	46
1,500–1,999	15	63	9	37	..	..	24
2,000 or over	30	63	18	37	..	..	48
No income reported	66	44	72	49	10	7	148
TOTAL	322	..	394	..	64	..	780

Fifty-two families included in the study did not depend on farming as a source of income; however, they reported having gardens and some livestock. Approximately one-half of these families had good diets; slightly less than one-half had fair diets; and only two had poor diets.

Place of Living. More than four-fifths of the families included in the study lived in rural areas, slightly less than one-fifth lived in small towns and four families lived in cities (Table 9). A slightly larger percentage of families living in small towns had adequate diets than those living in rural areas. Many of the families living in small towns owned farms and had gardens, orchards and livestock.

The same trend of a slightly higher per cent of adequate diets for families living in small towns existed when comparing the different areas, in all cases except the sugar cane and strawberry areas, where rural families were found to have a slightly higher per cent of adequate diets than families living in small towns.

TABLE 9. TOTAL DIET STANDARD IN RELATION TO TENURE OF OPERATION AND PLACE OF LIVING WITHIN THE FIVE AREAS.

AREA AND TOTAL DIET STANDARD	TENURE OF OPERATION						Total Families Reporting	PLACE OF LIVING						Total Families Reporting
	OWNER		TENANT		OTHERS			RURAL AREA		SMALL TOWN		CITY		
	Number	Per Cent	Number	Per Cent	Number	Per Cent		Number	Per Cent	Number	Per Cent	Number	Per Cent	
RICE:														
Good	43	55	18	44	6	86	67	55	51	13	57	3	75	71
Fair	31	39	19	46	1	14	51	44	41	9	39	1	25	54
Poor	5	6	4	10	..	..	9	8	8	1	4	..	..	9
TOTAL	79	100	41	100	7	100	127	107	100	23	100	4	100	134
STRAWBERRY:														
Good	12	46	..	..	1	50	13	10	37	2	29	..	..	12
Fair	12	46	6	86	1	50	19	16	59	3	42	..	..	19
Poor	2	8	1	14	..	..	3	1	4	2	29	..	..	3
TOTAL	26	100	7	100	2	100	35	27	100	7	100	..	..	34
SUGAR CANE:														
Good	4	25	..	..	..	..	4	4	10	..	..	..	..	4
Fair	9	56	11	61	9	82	29	22	57	8	100	..	..	30
Poor	3	19	7	39	2	18	12	13	33	..	..	..	..	13
TOTAL	16	100	18	100	11	100	45	39	100	8	100	..	..	47

TABLE 9. TOTAL DIET STANDARD IN RELATION TO TENURE OF OPERATION AND PLACE OF LIVING WITHIN THE FIVE AREAS. (*Continued*)

AREA AND TOTAL DIET STANDARD	TENURE OF OPERATION						Total Families Reporting	PLACE OF LIVING						Total Families Reporting
	OWNER		TENANT		OTHERS			RURAL AREA		SMALL TOWN		CITY		
	Number	Per Cent	Number	Per Cent	Number	Per Cent		Number	Per Cent	Number	Per Cent	Number	Per Cent	
NORTHEAST LOUISIANA DELTA AND RED RIVER DELTA:														
Good	76	52	28	31	10	71	114	96	42	20	67	..	..	116
Fair	66	45	47	52	4	29	117	113	50	9	30	..	..	122
Poor	5	3	16	17	..	..	21	18	8	1	3	..	..	19
TOTAL	147	100	91	100	14	100	252	227	100	30	100	..	..	257
UPLAND COTTON, BLUFF AND CUT-OVER LAND:														
Good	78	38	20	35	11	61	109	83	36	29	48	..	..	112
Fair	117	56	32	56	7	39	156	129	57	30	50	..	..	159
Poor	13	6	5	9	..	..	18	16	7	1	2	..	..	17
TOTAL	208	100	57	100	18	100	283	228	100	60	100	..	..	288
GRAND TOTAL	476	..	214	..	52	..	742	628	..	128	..	4	..	760

Size of Family. In studying the relationship between the size of the family and the total diet standard, families were classified as small, average and large. A family including three or less was classified as small, a family including four or five was average and a family including six or more was classified as large. Thirty-seven per cent of the families were classified as small, 41 per cent average and 22 per cent large. The size of families seemed to have no effect on the total diet standard for the five areas comprising the study; however, slight differences did exist when the areas were studied separately.

SUMMARY AND CONCLUSIONS

Written records of foods served over a seven-day period were obtained from 780 Home Demonstration Club members' families in Louisiana. Five agricultural areas, comprising a total of 27 parishes, were represented in the study. This study was made for the purpose of recording information regarding the adequacy of diets of club members' families, the influence of home-produced and home-conserved foods, income, farm tenure, size of family and place of living (whether urban or rural) upon the adequacy of diet.

The results of this study reveal differences in the adequacy of diets in the five areas. Families living in the rice area had a slightly higher percentage of good diets than those living in the other four areas. The northeast Louisiana delta and Red River delta area ranked second in per cent of good diets; the upland cotton, bluff and cut-over land ranked third; the strawberry area fourth; and the sugar cane area, fifth.

Adequacies of the 10 protective foods and food groups in the total diets showed considerable variation. Lean meat and meat substitutes scored good more frequently than any other food group; egg consumption ranked second; milk consumption, third; green, leafy and yellow vegetables, fourth; other cooked vegetables, fifth; other fruits and certain raw vegetables, sixth; citrus fruits and tomatoes, seventh; butter, eighth; potatoes, ninth; and whole grain cereals, tenth.

Servings of non-protective foods, including fat meats, refined starchy foods and sweets, increased as the adequacy of the diets increased. These foods apparently did not replace the essential food groups but seemed to supplement the serving of protective foods used by the families.

More families canned adequate amounts of vegetables than fruits. Home canning seemed to influence the adequacy of diets in most areas. The quantity of vegetables used from the gardens and the vegetables planted for future use also increased as the adequacy of the diets increased.

The number of milk cows owned by the families increased along with an increase in the adequacy of diets. A similar increase appeared in lean meat consumption as the number of hens and brood sows owned and beeves slaughtered for home use increased.

About one-half of the families included in this study were within the income class of $0-$499 per year. There was a tendency for diets to become progressively better as incomes increased. More adequacies were found in diets of tenant families than in diets of families who owned their homes. The adequacy of diets did not seem to be influenced appreciably by the size of the family.

The findings of this study indicate that families practicing diversified farming have a larger variety of protective foods than families that are inclined to follow a one-crop system of farming. These data further suggest that home produced and conserved foods and the ownership of farm land and farm animals tend to increase the adequacy of the diets.

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LOUISIANA BULLETIN 357 MARCH, 1943

DISEASES OF SOME VEGETABLE AND FRUIT CROPS AND THEIR CONTROL

By

A. G. PLAKIDAS

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DISEASES OF SOME VEGETABLE AND FRUIT CROPS AND THEIR CONTROL

A. G. Plakidas

INTRODUCTION

The need for a convenient handbook of plant diseases and their control has been felt in the state for a long time. Bringing together, under the same cover, of the scattered information on the diseases of various crops and their control would obviously be of great help and convenience to both growers and county agents. Such a handbook has not been published earlier because it was felt that not enough experimental work on control measures of various crop diseases had been done in the State to have first-hand information. It is not always safe or practical to base recommendations for control on studies made elsewhere because environmental conditions vary so much that a certain control measure which has been found very effective in one part of the country may be worthless in another part. Information based on local studies, whenever available, is always more desirable.

During the past several years, considerable work has been done by different workers of the Louisiana Agricultural Experiment Station on the causes and control of diseases of various crops. Much valuable information has accumulated from these studies, and it is the purpose of this bulletin to place this information in the hands of farmers of the State.

Another reason for publishing this bulletin at this time is the hope that it may be helpful in the farm food production program. One way of increasing food production is by controlling the diseases which rob the farmer of a large part of the fruits of his labors. The acute scarcity of farm labor makes it difficult for the farmer to produce more by planting more acres, but he can produce more per acre by controlling the disease and insect pests of his crops.

No attempt has been made to include all crops grown in Louisiana or all diseases of each crop. The important diseases of only the vegetable and fruit crops are considered. Consequently, some of the most important crops of the State, namely, sugarcane, rice, cotton, and corn, are not included.

CAUSES OF PLANT DISEASES

It will probably be easier to understand the discussion of the individual diseases and their control if a brief, general account of the causes of plant diseases and troubles is presented first. The different causes of plant diseases and troubles are given in the following outline:

- I. Parasitic Diseases
  - 1. *Fungi*
  - 2. *Bacteria*
  - 3. *Nematodes*
  - 4. *Insects*[1]
- II. Non-parasitic Diseases
  - 1. *Unfavorable climatic conditions*
  - 2. *Adverse soil conditions*
  - 3. *Noxious gases*
- III. Virus Diseases

Fungi are the most important plant-disease producing organisms. They are minute organisms composed mostly of a thread-like body (the "mycelium") and of microscopic fruits (the "spores"). The spores may, for convenience, be termed the "seed" of the fungi because it is by means of these organs that fungi are disseminated and infect the plants. Fungi cause many different kinds of diseases. They may attack the underground parts of the plant causing various root rots; they may attack the above-ground parts causing various cankers on the trunk and branches, rusts and mildews, leaf spots, blights of leaves and flowers, and various rots and molds of different fruits; or they may invade the vascular system of the roots and stems to produce wilting. The combating of fungus diseases is, therefore, a complicated process. It is necessary to know the life history of the particular fungus involved in order to know when to apply the fungicide to do the most good. Generally speaking, fungus diseases occurring on the above-ground parts of a plant are fairly easily controlled by sprays or dusts. The soil-inhabiting fungi which attack the roots and those that invade the vascular system of the stems are most difficult to control.

Bacteria are microscopic organisms much smaller than fungi. Like fungi, bacteria are capable of causing a great diversity of diseases. They too can invade the vascular system of plants and cause wilts. They can attack leaves, stems, shoots, blossoms, and fruit of different plants and cause serious blights (bean blight and fire blight of pears and apples, for example). In addition, bacteria can attack roots and crowns, which results in the formation of swellings and knots (crown gall). They can cause cankers on trunks and branches of trees, and various rots on fruits and vegetables. Bacterial diseases are much more difficult to control by sprays and dusts than are those caused by fungi.

Nematodes are microscopic animals (eelworms). The most common and most destructive species is the one that causes galls or knots on the roots of many plants (root-knot nematode). Others prefer to feed inside the crowns of certain plants (see "strawberry dwarf," page 82) and some can attack the leaves, stems, and flowers of different plants. The root-knot nematode is very difficult to control. It is very common in the South, especially in light sandy soils. It can attack a very large number of different plants (over 800 kinds of plants are known to be affected) and it can survive in the soil outside the plant for a long time.

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[1] The injuries caused by insects are not considered in this bulletin. A separate bulletin describing the insect pests of various crops and their control is in the process of preparation by the Department of Entomology and will be released soon.

Non-parasitic diseases are caused by adverse climatic or soil conditions, such as cold, heat, drought, poor drainage, unfavorable soil reaction (acidity or alkalinity), general infertility of the soil, lack of one or more of the "minor elements" (zinc, manganese, copper, boron, etc.), excess of soluble salts, or the presence of a toxic substance in the soil, etc. In cities and in the vicinity of industrial plants, smoke and poisonous fumes may cause injury.

For convenience, virus diseases have been placed in a separate group instead of being included either among the parasitic or the non-parasitic causes, because it is not definitely known whether viruses are living or non-living. In some ways viruses behave like living organisms and in other ways like non-living chemical substances. What is known is that viruses are ultramicroscopic (they cannot be seen even with the strongest microscope) entities which, when introduced into the plant, increase and spread very rapidly, and produce specific diseases which are often very destructive. Virus diseases are spread chiefly by insects (aphids, leafhoppers, thrips, etc.) which feed on diseased plants and then on healthy ones, but some can also be spread mechanically during handling operations. Tomato mosaic, for example, is often spread during pruning and staking.

Viruses produce a great variety of symptoms depending on the kind of virus and often on the kind of plant. Some of these symptoms are green and yellow mottling of leaves ("mosaic"), general yellowing or chlorosis ("yellows"), dwarfing and stunting of the growth of the entire plant, distortion or rolling of leaves, dead spots on leaves or stems, etc. Often there is a combination of several of these symptoms.

Section I. Vegetable Diseases

BEAN

Anthracnose

Symptoms: This disease, which is caused by a fungus (*Colletotrichum lindemuthianum*), affects all part of the bean, seed, stem, leaves, and pods. The spots on the pods are the most conspicuous symptom (Fig. 1). Mature spots on the pods are sunken in the tissue, black with brownish margins. In the presence of moisture, the centers of the spots may become flesh-colored. On the stems the cankers are at first brown in color, later becoming black and sunken. The symptoms on the leaves are angular dead areas on the upper surface and blackening and killing of the veins on the under surface. The petioles also are affected.

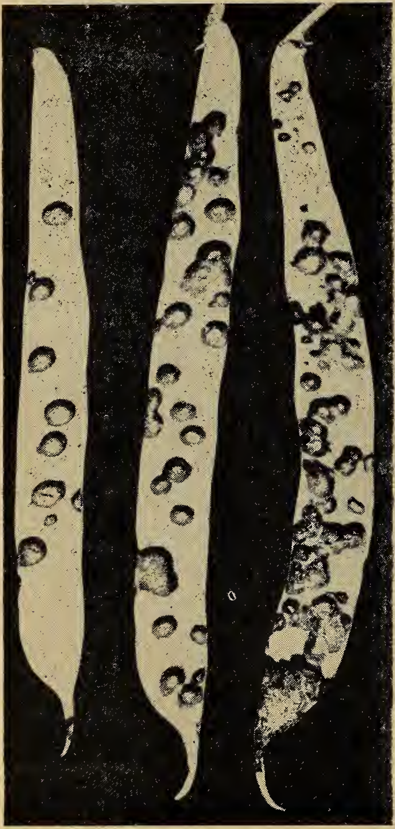

FIGURE 1. — BEAN ANTHRACNOSE. SYMPTOMS ON PODS.

Control: Control of anthracnose is based on the fact that the disease is seed-borne. The organism causing the disease does not survive the high temperatures of Louisiana summers. Therefore, if disease-free seed is planted in the spring, the beans will be free of anthracnose. In former years, when most of the bean seed planted in Louisiana was grown in the cool, humid, northern states (chiefly Michigan) bean anthracnose was very serious. In recent years, with the planting of Western-grown seed (seed grown in the arid, irrigated areas of the West where anthracnose is not prevalent) the disease has been practically eliminated and it has ceased to be of economic importance in Louisiana. This point should be kept well in mind in connection with the control of another seed-borne disease of beans, bacterial blight, which is discussed next.

Bacterial Blight

Symptoms: There are really two blights of beans, the common blight and the halo blight. These are caused by two distinct species of bacteria. Common blight is caused by *Phytomonas phaseoli* and halo blight by

Phytomonas medicaginis var. *phaseolicola.* They differ in symptoms somewhat, the chief difference being that the dead spots on the leaf caused by the halo blight organism are surrounded by distinct yellow halos (Fig. 2), while those of the common blight are not. For practical purposes, however, and especially from the point of view of control, the two diseases may be treated as one because both have many things in common. Both are seed-borne. Both may affect all parts of the plant—seed, seedlings, stems, leaves, and pods of the mature plant; and both may be very destructive under conditions favorable for infection and spread. The spots on the leaves have a water-soaked ("greasy") appearance at first, and in the case of halo blight are usually surrounded by a yellow halo. Later the spotted leaf tissue dies and turns brown. When the spots are numerous, there are no distinct halos, but the entire leaf turns yellow. When infection starts early, the entire plant is severaly stunted and may be killed outright. The spots on the pods also start as water-soaked ("greasy") areas resembling sunscald, but may become reddish-brown on drying. The spots may be separate and more or less circular, or may run together forming irregular water-soaked areas on the pod (Fig. 2).

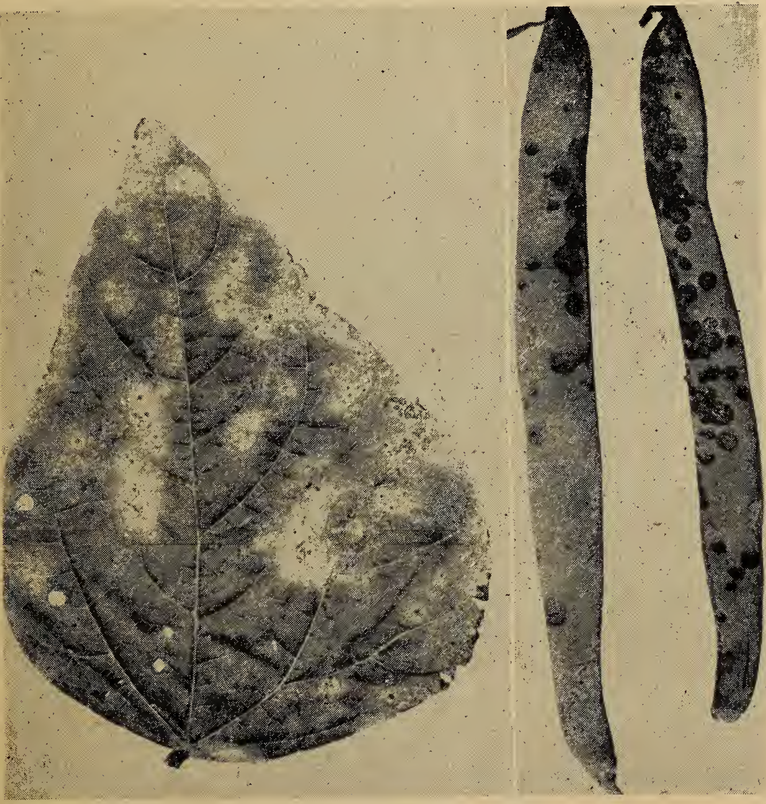

FIGURE 2.—Bacterial Blight of Beans. Symptoms on Foliage and Pods.

Control: In discussing control for bean blight, the following facts should be emphasized: (1) The disease is seed-borne; (2) the bacteria occur *under* the seed coat where ordinary seed disinfectants cannot reach them; (3) sprays have not given satisfactory control; and (4) under Louisiana conditions the blight bacteria do not survive in the soil from one year to the next. With these facts in mind it is apparent that the logical way to control bean blight is to plant blight-free seed. Until recently, blight-free seed was not available. Seed grown in the cool, humid northern states almost invariably contains a large percentage of blight infection. For this reason, many seed companies in recent years have been growing their seed in the semi-arid sections of the West. This practice, unfortunately, has not resulted in the production of completely blight-free seed. It must be emphasized at this point that if the seed contains even a very small amount of blight, the disease may spread in the field very rapidly if conditions (chiefly wind and splashing rains) are favorable for infection and spread. It is, therefore, not enough to have seed that is *almost* blight-free. To get complete protection against blight it is necessary to plant seed which is *entirely* blight-free.

Through the efforts of the Plant Pathology Department of the Louisiana Agricultural Experiment Station and the cooperation of the University of California, blight-free seed has been produced in one of the dry areas of the Sacramento Valley in California where there is no summer rainfall, and beans are grown under irrigation. Carefully conducted field tests in Louisiana during the past three years have shown that the California-grown seed was completely blight-free. For the protection of the buyer, bags containing this seed are sealed with a specially devised metal seal which automatically breaks when the bag is opened. Thus, if the seal is not broken the buyer is assured that the seed has not been tampered with. In addition to the metal seal, the bags bear a tag with the inscription "CALAPPROVED." This is the stamp of approval of the University of California and means that the seed so labeled has been grown under its supervision.

Caution: It is very important to remember that this California-grown seed is *blight-free,* not *blight-proof.* None of the commercial varieties of snap beans is blight-proof—not even blight-resistant. Plants from California-grown seed will blight if they come in close contact with plants grown from blight-infected seed. Therefore, never mix California-grown seed with seed from other sources. If enough seed is available, make all plantings with California-grown seed. If enough California-grown seed is not available and you have to use seed from other sources, plant the California-grown seed separately, at least removed by a quarter of a mile.

Web Blight

(*Rhizoctonia microsclerotia*)

Description: This is a new disease which has been in the State for only about four years, but which has proved that it can be very destructive in seasons in which weather conditions are favorable for its development. In 1941 it destroyed over 75 per cent of the fall crop of beans in the State. The first symptoms of the disease include a scalding of some of the leaves, and the appearance of spots or cankers on the pods. Affected leaves cling to other leaves or to stems and when pulled apart it is seen that they are held together by means of a cobweb-like material. Later the whole plant may become blighted, and leaves and stems become peppered with minute, dark-brown bodies (the sclerotia of the web-blight fungus) which look somewhat like grains of sand.

Control: No method of control is known for web-blight. The fungus causing the disease lives in the soil and it is scattered by winds and rain. It attacks not only beans, but a very large number of other plants including trees, such as the fig. Rotation probably would not help. In the fall of 1941 the disease destroyed the crop in many fields in which beans had never been planted before. Fortunately, the disease is not bad every year. It thrives in hot, humid weather. It hardly ever occurs on the spring crop of beans because the weather then is relatively cool and dry. For the same reason early plantings of fall beans suffer more than late plantings. In the fall of 1941, for example, most early plantings were completely destroyed, while later plantings escaped. The fall of 1941 was very warm, unseasonably hot weather prevailing throughout September and October.

Mosaic

(*Virus*)

Symptoms: Leaves become mottled (irregular light yellow areas on the green leaf), puckered, and deformed (Fig. 3). The whole plant is somewhat stunted and of a sickly yellow appearance. If infection starts

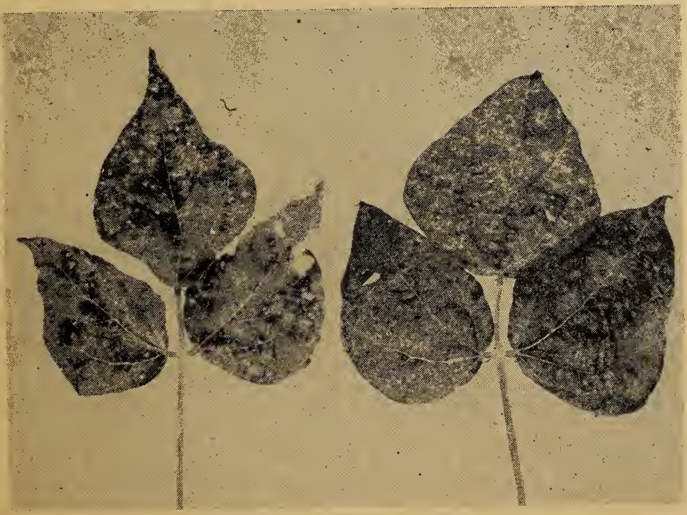

FIGURE 3.—Bean Leaves Showing Mosaic Symptoms.

when the plant is young, very few pods are formed, and those that form are of inferior grade. On some varieties, at least, (Black Valentine and Tendergreen in particular) mosaic causes water-soaked irregular spots on the pods. This type of injury has been termed "water wave" by inspectors, and beans so affected fail to make the U. S. No. 1 grade.

Control: The bean mosaic is seed-borne. There is no cure for mosaic once the plant becomes infected. With the use of certified seed, the amount of initial infection is small. Bean mosaic is relatively of minor economic importance in the State.

Rust

(*Uromyces phaseoli typica*)

Rust rarely occurs on the spring crop of bush beans in this State and is not a factor to be reckoned with in the commercial production of snap beans. The disease is, however, often found on pole beans in gardens later in the season, often becoming very destructive. Sulphur dusts or wettable sulphur sprays have proved very successful for the control of bean rust in Florida. We have had no experience with the use of sulphur on beans in this State, but there is every reason to believe that it should control rust on pole beans. It should be used cautiously, however, for it may cause some burning of the foliage during hot and dry weather usually prevailing in June.

Root Knot

(*Heterodera marioni*)

In spite of the fact that beans are very susceptible to the root-knot nematodes, the injury caused to the spring crop is insignificant. This is because soil temperatures are still relatively cool in the spring and the nematodes are not very active. On the fall crop of beans considerable injury may sometimes be caused by the root-knot nematode, especially on sandy soils. It is advisable to avoid, as far as possible, the planting of fall beans on very sandy soil in a field which is known to be heavily infested with nematodes.

BEET

Seed treatment: Better germination and better stands are obtained if the seed is treated. Use either Cuprocide or Vasco 4 (see pages 87 and 88).

Leaf spot: Spots with brown to grayish center and purplish borders appear on the leaves. These are caused by a fungus parasite (*Cercospora beticola*) which is seed-borne. The fungus causing leaf spot is a warm weather organism, so spots usually do not develop until relatively late in the season and injury caused from this disease is too small to justify control measures. Spraying with 4-4-50 Bordeaux will check the disease, but in general spraying is not practical.

CABBAGE, COLLARD, CAULIFLOWER, BROCOLI, BRUSSELS SPROUTS

These plants of the crucifer family are all affected more or less by the same diseases and insect pests, so they are all treated here as a group.

Black Rot

(Bacterium campestre)

Description: This is one of the most destructive diseases of crucifers. The organism causing the disease is seed-borne and may affect the plant at any stage of its growth, from seedling to maturity, in the seed bed or in the field. Symptoms vary with the age of the plant. However, one symptom is nearly always present, and that is the blackening of the leaf veins and vascular bundles of the affected leaves and stems (Fig. 4). Affected leaves usually turn yellow and drop off. Secondary organisms (soft rot bacteria) often invade affected tissues causing a soft rot with a very offensive odor.

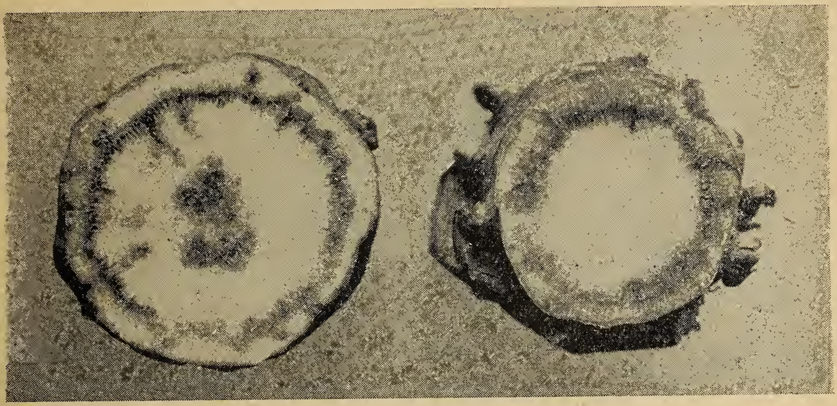

FIGURE 4.—Black Rot of Cabbage. Section of Stem Showing Conspicuous Ring of Black Vascular Bundles.

Control: The germ causing black rot is carried on the seed, so the control of black rot is accomplished by treating the seed with corrosive sublimate (bichloride of mercury). Make a 1-1000 solution of corrosive sublimate. This is most conveniently made by using the blue tablets which can be purchased at the drug store. One tablet in one pint of water makes a 1-1000 solution. Place the seed in a cloth bag and soak in the solution for 20 minutes. Then wash it in running water for 15 minutes, or if there is no running water, change the water several times. Spread the washed seed out to dry.

Caution: Corrosive sublimate is a deadly poison if taken internally and should be kept away from children and livestock. It is not, however, dangerous to the hands. Corrosive sublimate should not be dissolved in a metal container. Use either a glass, porcelain, or wooden vessel.

The hot water treatment (see "black leg") is also effective against black rot. Therefore, it is not necessary to treat seed which has been hot-water treated with corrosive sublimate.

Black Leg

(*Phoma lingam*)

Description: This disease is mentioned not so much for its present importance—for in recent years black-leg has rarely been seen in the State—but because it is potentially one of the most destructive diseases of cabbage and allied plants. The disease may affect any part of the plant in the seed bed, in the field, or in storage, but primarily it rots the roots and stems, causing the collapse and death of the plants. In the seed bed, affected seedlings show whitish sunken dead areas on the stems. Very numerous, minute specks dot the surface of the killed tissue. These are the fruiting bodies of the organism causing the disease. These bodies produce millions of spores which in turn infect other plants in the seed bed or in the field, if conditions are favorable. Infected seedlings usually die soon after transplanting. Older plants in the field may collapse and die at any time.

Control: Black-leg is another of the many diseases that are seed-borne. To control black-leg, then, it is necessary either to plant disease-free seed or to treat the seed. Seed produced in the Puget Sound district, where black-leg does not normally occur, is free of infection and requires no treatment for the control of black-leg. If the seed has been grown in a region in which black-leg is known to occur it is necessary to treat it. The black-leg fungus occurs both on the surface and inside the seed. The corrosive sublimate treatment (see "black rot") will kill the fungus on the outside but not on the inside of the seed. Treating the seed with hot water (see page 88) will kill the fungus inside the seed. The hot water treatment is a delicate and drastic method of control and should not be used except when absolutely necessary. It reduces the germination of the seed considerably.

Damping-Off

(*Caused by several soil fungi*)

Description: The term "damping off" has been used to designate a disease of seedlings of many different plants, in the plant bed or in the field, which causes the seedlings to rot at the soil line and collapse suddenly.

The soil contains various fungi which are capable of causing damping-off of seedlings of many different plants. Damping-off damage is of two kinds. Germination may be considerably reduced by the rotting of the seed or of the young seedlings while still under ground (pre-emergence damping-off); or the seedlings may be killed after germination (post-emergence damping-off).

Control: In recent years various seed treatments have been devised which are giving very satisfactory control of damping-off of many different crops.[2] For cabbage, cauliflower, broccoli, brussels sprouts, collard. radish, turnip, mustard, kohlrabi, rutabaga, and spinach, Vasco 4[3] has given the best results for the control of damping-off. Add one level tablespoonful of Vasco 4 per pound of seed in a closed container, shake until the seed is well covered, then screen off any excess dust. If the seed are to be planted with a drill, add one-half as much graphite dust as the Vasco 4 when treating. This reduces friction in the drill. In the seed bed, it is well to cover the surface of the soil with a thin layer of Vasco 4, or of zinc oxide, as soon as the seedlings begin to come up.

Blind Plant

Description: During the past few years a peculiar trouble of cabbage, collard, cauliflower, and brussels sprouts has been noted. The trouble has been variously designated by different growers, the name "blind plant" being the one most commonly used. The symptoms of this trouble are briefly as follows: Some of the older leaves (especially those of cauliflower) are narrow and malformed (whiptail) ; there is considerable cupping of the margins of some of the leaves; the young leaves near the growing points may show bronzing, brittleness, and tip-burning; the growing point is often killed, the plant becoming "blind"; cauliflower may not head at all, or may form only small imperfect heads.

The cause of this trouble is not definitely known, but it seems to be associated with acid soils. The trouble has been especially common and severe in the southeastern part of the State (Florida Parishes) where the soils are definitely acid. It is not known whether soil acidity as such is the cause of the trouble, or whether under conditions of high soil acidity some element, such as manganese, becomes soluble in sufficient quantities to be toxic. In some respects, the trouble appears similar to that which effects cotton in some fields in the same general area which has been shown to be due to manganese toxicity.

Control: Liming appears to correct this condition. Before planting cauliflower or other crucifers on soil which is suspected of being acid, have your soil tested. Consult your county agricultural agent on how to get a sample of your soil and where to send it to be tested. In this way you can find out if liming is necessary and how much lime it is advisable to apply.

CARROT

Seed treatment: Better germination and better stand are obtained if the seed is treated. Use either Cuprocide or Vasco 4 (see pages 87 and 88).

Leaf spot: The disease is caused by a fungus (*Macrosporium carotae*). It causes grayish spots on leaves and leaf stalks, finally killing the outer leaves.

Control: In small garden plots the disease is hardly ever severe enough to require control, but in larger plantings it may become very destructive.

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[2] Write to the Louisiana Agricultural Experiment Station for Bulletin No. 349.

[3] Vasco 4, a product of the Virginia Smelting Company, West Norfolk, Va., is a combination of zinc oxide and zinc hydroxide. It is on the market and can be bought at any seed store. If Vasco 4 is not available, zinc oxide may be used in its place.

The disease can be controlled by about 3 applications of 4-4-50 Bordeaux spray.

CUCUMBER, CANTALOUPE, WATERMELON, SQUASH

Plants of the cucurbit family are subject to a very large number of diseases. Some of these are of universal occurrence and importance; others are of great economic importance in some regions and relatively unimportant in others. While practically all the diseases that affect cucurbits occur in Louisiana, only the ones that are of economic importance are included in this bulletin.

Downy Mildew (Blight)

(*Peronoplasmopara cubensis*)

Although downy mildew affects practically all cucurbits, in Louisiana it is primarily a disease of the fall crop of cucumbers. Spring crops of cucumbers, cantaloupes, and watermelons either escape infection or become infected late in the season when the crop is nearly over and the resulting damage is small, although in some years severe defoliation of cantaloupes and watermelons may occur. Fall cucumbers, on the other hand, become infected almost as soon as the plants come up. The reason for the difference between spring and fall crops is this: The mildew fungus is a hot weather organism and does not survive the winter in Louisiana. It passes the winter in southern Florida and as the weather warms up in the

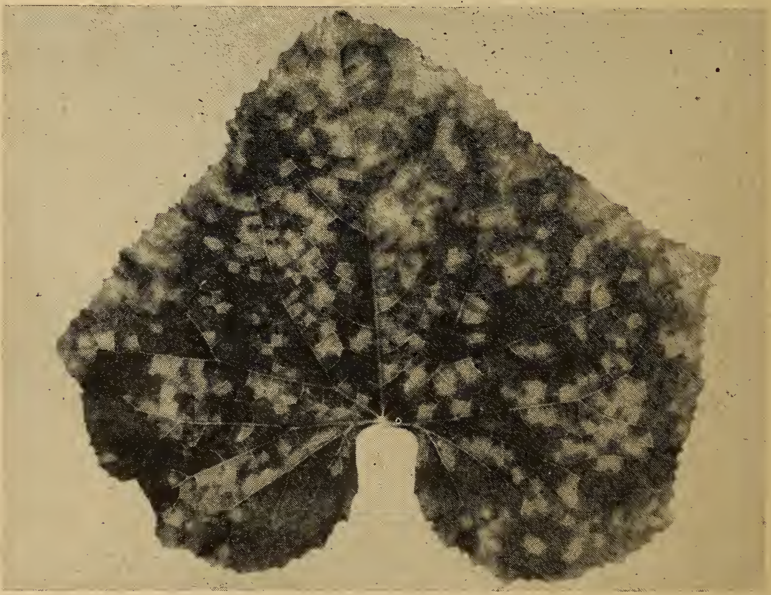

FIGURE 5.—DOWNY MILDEW (BLIGHT) OF CUCUMBER. EARLY STAGE SHOWING THE NUMEROUS, ANGULAR, YELLOW SPOTS ON THE LEAF.

spring it spreads north gradually, reaching Louisiana usually the last part of June or early July.

Symptoms: Yellowish spots, usually angular in shape (Fig. 5), appear on the leaves. Later the whole leaf shrivels. The older leaves are killed first so there is a progressive defoliation from the base of the vine toward its tip. Diseased vines produce very little fruit of marketable grade.

Control: The standard method of control of downy mildew on cucumbers in Louisiana is to spray often (about twice a week) with 4-4-50 Bordeaux. Insecticides such as calcium arsenate or lead arsenate and Black Leaf 40 are added to the Bordeaux to take care of the insect pests (beetles, worms, aphids). This method has been in practice for many years and has proved fairly satisfactory. However, this method has these disadvantages: (1) In spite of frequent applications it is not entirely effective against mildew and it gives relatively poor control of the insect pests; and (2) under certain conditions Bordeaux causes injury to the plant (stunting of growth and burning of leaves and flowers) which results in reduced yields (Fig. 6).

It has been felt for years that a better method of control than that afforded by Bordeaux spray is needed. Since it is known that the lime component of Bordeaux causes the injury, it was decided to test some of the fixed copper compounds (which contain no free lime) in the form of dusts and sprays as substitutes for Bordeaux. Results obtained so far indicate that copper dusts with 5-6 per cent copper content plus a suitable insecticide give better control of mildew and insects than the Bordeaux spray. In some cases as high as 50 per cent increased yields were obtained from dusted cucumbers over those sprayed with Bordeaux. The increased yields were due to two reasons: (1) The dust caused no injury to the plant; and (2) the dust gave better control of insects, especially the cucumber worms, and as good control of the mildew as the Bordeaux.

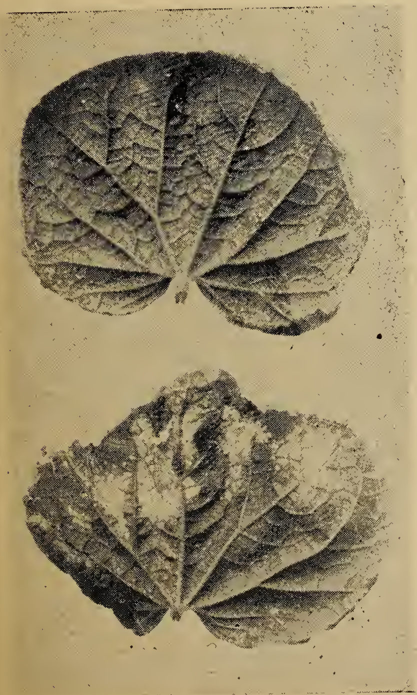

FIGURE 6.—Bordeaux Injury to Cucumber. Note Marginal Burning, Stunting, and Spot Burning of Leaves.

Dusting experiments were started in 1938. In 1938 and 1939 the dust used was supplied by the General Chemical Company of New York. This dust contained 6 per cent copper in the form of basic copper sulphate, 20 per cent arsenicals (zinc arsenate and calcium arsenate), and 0.08 per cent rotenone. In 1942, two different dusts were tried:

"Blue Cucumber Dust" containing 6 per cent copper in the form of tribasic sulphate (supplied by the Tennessee Copper Company) and 34 per cent Cryolite; and "Red Cucumber Dust" containing 5% Cuprocide (yellow copper oxide) and 34 per cent Cryolite. Nicotine in the form of "Black Leaf 10" was mixed with these dusts at the rate of 1 per cent when aphids appeared on the plants.

All the dusts used gave good control of mildew and excellent control of the insects. Several growers who have used dusts said that they are so well pleased with the results that they will never go back to spraying. So it looks as if dusting will eventually supplant spraying for cucumbers.

It should be emphasized, however, that our experiments with dusting versus spraying are not completed. In order to produce dusts that will be as cheap as possible, further tests will be carried out to determine the minimum amounts of copper and insecticides that can be put into dusts and still have satisfactory control. Work is also in progress to devise some sort of inexpensive power duster that will be suitable for cucumber dusting. When this experimental work is completed, recommendations on the best method of control of mildew and insects of cucumbers will be made. For the present, either of the following control measures are recommended:

1. *Spray.* Spray twice a week with 4-4-50 Bordeaux plus 2 lbs. of lead arsenate or calcium arsenate per 50 gallons of spray. If aphids (lice) are present, add ¾ of a pint of Black Leaf 40 to 50 gallons of spray. This method, while it has many disadvantages, has stood the test for years and is known to be reliable.

2. *Dusts.* Dust twice a week with a dust containing 5 to 6 per cent copper and 34 per cent Cryolite. If aphids (lice) are present, mix with the dust one per cent Black Leaf 10. This material is very volatile and should be kept in an air-tight container. It should be mixed with the dust immediately before dusting. Apply the dust either early in the morning when the plants are wet with dew or as late as possible in the afternoon.

Two dusts which are on the market as "Blue Cucumber Dust" and "Red Cucumber Dust" are suitable and easily obtainable. Dusts can also be obtained from the Farmers and Merchants Grain Company in Ponchatoula, La., where a dust-mixing plant has been recently installed.

Root Knot

(*Heterodera marioni*)

Cucurbits are among the plants most susceptible to the root knot nematode (see page 4). Plants affected with root knot are stunted in growth, pale green and unthrifty in appearance. When dug and examined, their roots are found to be covered with swellings or knots.

Control: See under TOMATO, page 47.

Bacterial Wilt

(*Erwinia tracheiphila*)

Symptoms: The first noticeable symptoms is the wilting of a few leaves or of a single branch of the vine. This is soon followed by the sudden wilting of the entire plant. When the stem is cut and squeezed, a sticky whitish ooze exudes from the cut surfaces. This is a reliable means of telling bacterial wilt from Fusarium wilt, which is discussed next.

Control: Bacterial wilt is caused by a species of bacteria (*Erwinia tracheiphila*). These bacteria, as far as known, are not seed-borne and do not survive in the soil or in plant refuse. They pass the winter within the bodies of the cucumber beetles and the plants become infected when the beetles feed on them. Therefore, the only effective control for bacterial wilt is to control the beetles. The beetles are easily controlled by dusting the plants with calcium arsenate or with cryolite. In the case of cucumbers which are sprayed or dusted for the control of downy mildew, the arsenical or cryolite is mixed with the spray or dust.

Cucumber and cantaloupe are very susceptible to bacterial wilt; watermelon is very resistant, and squash is intermediate.

Fusarium Wilt

This wilt, which is caused by a fungus (*Fusarium niveum*), is primarily a disease of watermelon. Cucumber, cantaloupe, squash, and pumpkin are not affected.[4]

Symptoms: The wilt fungus may affect the plant in all stages of its development. It can cause rot of the seedlings underground before they emerge, wilt and damping-off of the seedlings after emergence, and wilt and death of older plants. Wilt shows first at the tips of the runners during the hot part of the day. Wilted vines at first recover during the night, only to wilt again the next day. Wilting becomes progressively more severe, and the vine finally dies.

Control: Control of watermelon wilt is a difficult problem. The wilt fungus can live in the soil outside the plant, and once a field becomes infected it remains so for a long time. Furthermore, the wilt fungus is seed-borne, and in this way it may be spread to new ground if infected seed is planted. Seed-borne infection is not important the first year watermelons are planted on wilt-free soil, because only relatively few seeds will harbor the fungus, but it is important from the point of view of dissemination of the disease to new fields.

A five-year rotation, that is, not planting watermelons in the same field any oftener than once in 5 years, offers a practical relief against wilt. The wilt fungus is not eliminated from the soil in 5 years (it is known that it persists in soils 16 years or longer), but it is reduced to the point where watermelons can be grown for one season without much loss from wilt.

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[4] Other species of *Fusarium* have been reported as causing wilts of muskmelon, squash, and pumpkin elsewhere, but as far as known these diseases do not occur in Louisiana.

Varieties of watermelon resistant to wilt have been developed. Unfortunately these have proved unsatisfactory in many respects. In general, the wilt-resistant varieties are of inferior quality compared to the susceptible ones. Also, some of these varieties which have shown considerable resistance further north are not resistant when planted in the deep South. Two varieties, the Leesburg and the Hawkesbury, show marked resistance to wilt in the South, and while these may not be of highest quality, they can be grown where the soil is so wilt-sick that no other varieties can be grown on it.

Anthracnose

Anthracnose, caused by the fungus *Colletotrichum legenarium,* affects watermelon, cucumber, cantaloupe, and other related plants, but in Louisiana, it is primarily a disease of watermelon and, to a lesser degree, of cantaloupe. Anthracnose is only rarely seen on cucumbers in Louisiana. This is due to two reasons: First, most cucumbers in the State are grown in late summer (August to October) and the high temperature prevailing at this time of the year is unfavorable for the anthracnose fungus. Secondly, even if conditions were favorable for the development of anthracnose, the spray for the control of downy mildew would also control the anthracnose.

Symptoms: Dead spots on leaves. These spots which are reddish brown on cucumber and cantaloupe and black on watermelon, enlarge until the whole leaf shrivels and scorches. The plant thus becomes defoliated to a large extent, and the fruit becomes sunscalded. Spots develop also on stems and fruits.

Control: Anthracnose is usually not serious enough in Louisiana to justify control measures. In Florida, where the watermelon crop is very important and where Anthracnose is the most serious disease of this crop, the following measures have been found effective: (1) Seed is disinfected by soaking for 10 minutes in 1-1000 solution of mercury bichloride, then rinsing well in several changes of water. This eliminates the seed-borne infection. (2) Plants are either sprayed with 4-4-50 Bordeaux or dusted with 20-80 copper lime dust. One spray or dust application is made when the first 2 or 3 leaves have formed, the second when the vines have begun to run, the third about one week after the fruit has set, and the fourth about two weeks later.

Southern Wilt

(See under PEPPER, page 30.)

Mosaic

(*Virus*)

Mosaic, which is caused by a virus (see page 5) is one of the most serious diseases of cucumbers in the North, but in Louisiana it is rarely seen on cucumbers. This is probably due to the fact that the insects which spread the virus from diseased to healthy plants are kept well under control in the process of spraying for downy mildew. Mosaic often occurs on squash in Louisiana, probably because this crop is not sprayed so assiduously as cucumbers. Watermelon is resistant to most strains of the mosaic virus and the disease is seldom seen on watermelon in the field.

Symptoms: Symptoms vary with different strains of the virus, but in general the leaves and fruit becomes mottled and distorted and the entire plant is stunted.

Control: Since mosaic is spread by insects, especially by plant lice, control is obtained by controlling the insects by spraying or dusting.

Powdery Mildew

(*Erysiphe cichoracearum*)

In Louisiana powdery mildew is of some importance only on squash. It is hardly ever seen on cucumber, cantaloupe, or watermelon.

Control: Powdery mildew on squash can be controlled by dusting with sulphur. Sulphur should not be used on cucumber or cantaloupe because these plants are sulphur sensitive and severe burning may result.

EGGPLANT

Damping-Off

(*Caused by several soil fungi*)

Eggplant seedlings are very susceptible to damping-off, and to control this trouble it is necessary to treat both the seed and the soil. Treat the seed with Cuprocide (see page 87). As soon as the seedlings begin to emerge from the ground, water the seed bed with a suspension made of 1½ oz. of Cuprocide (red or yellow) in one gallon of water. Repeat this once a week. Instead of watering with the Cuprocide suspension, the surface of the ground can be covered with a thin layer of Vasco 4 (see page 88) as soon as the seedlings begin to emerge. Leave the layer of Vasco 4 undisturbed.

Blight

(*Phomopsis vexans*)

Blight is by far the most serious disease of eggplants and it is really the limiting factor to the successful growing of eggplants in the State. It affects the plant and its fruit in all stages of development, from seedlings to mature fruit.

Symptoms: Brown dead spots form on the leaves. When the spots are numerous the entire leaf is killed. Elongated cankers develop on the main stem and its branches, usually occurring close to the ground. When the cankers girdle the main stem the plant wilts and dies. On the fruit, the disease shows sunken brown spots of various sizes (Fig 7). Sometimes these spots grow very large. Infected fruit usually sheds. The fruit tissue rots underneath the spots. Very numerous dark-colored pimples dot the surface of the cankers on the stem and of the spots on the leaves and fruit. These are the fruiting bodies of the blight fungus. They give rise to millions of spores which are scattered by winds and rains and spread the disease in other plants.

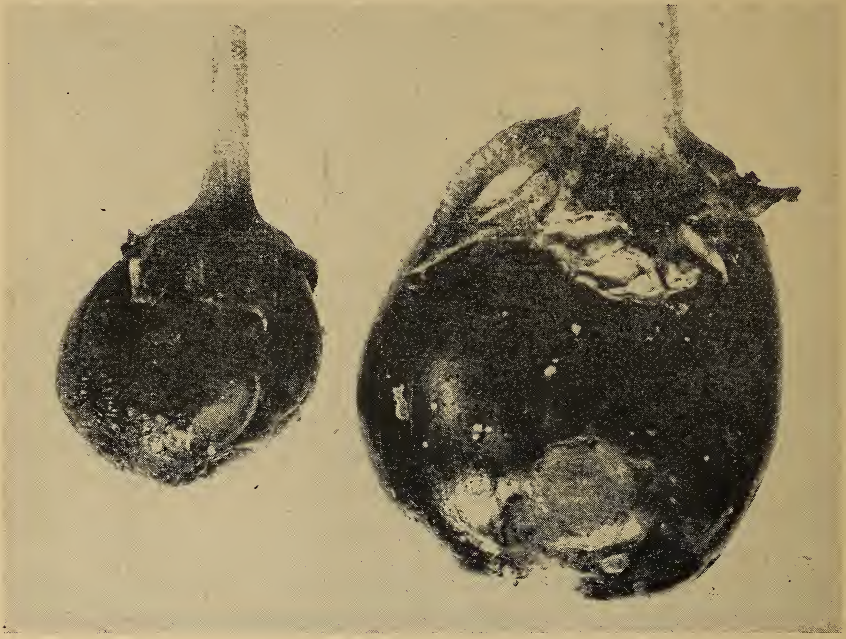

FIGURE 7.—Blight on Eggplant Fruit.

Control: Eggplant blight is one of the most difficult diseases to control under the weather conditions prevailing in the State in the summer. The disease is seed-borne, the causal organism occurring both on the inside and outside of the seed. The seed treatment recommended above for damping-off will kill the fungus on the surface of the seed and thus reduce the infection considerably. Seed treatment is strongly recommended but will probably not get the fungus inside the seed. Spraying with Bordeaux has given a fair control of the disease on stems and leaves but rather poor control on the fruit. Some varieties are more resistant than others. The Black Beauty, which is considered the best variety from the point of quality, is very susceptible. The Florida High Bush (New Orleans Market) is somewhat resistant.

To summarize, the following control measures are suggested: (1) Treat the seed; (2) grow the resistant variety; and (3) spray the young plants several times with Bordeaux to prevent early infection on the leaves and stems.

Yellows

(*Virus*)

Yellows is a new disease of the eggplant and is probably caused by a virus (see page 5). The upper leaves turn bright yellow, or sometimes bleach nearly white. Later the entire plant may become yellow and may finally die.

Control: In Texas, where the yellows disease is sometimes very prevalent in some sections, good control has been obtained by the use of sulphur dust. The plants in the seed bed are kept dusted with sulphur, then one or two additional dustings are given the plants after they are set out in the field. This apparently is a preventive measure. Sulphur evidently kills or repels the insect which transmits the yellows virus from diseased to healthy plants.

Although yellows has been found on eggplants in Louisiana, so far it has not become prevalent enough to be of economic importance.

OKRA

Okra is grown in practically every garden in Louisiana and is usually considered a "fool-proof" crop. However, this plant also is subject to several diseases, some of which may be destructive at times.

Wilt

Okra wilt is caused by the same fungus which causes the destructive wilt of cotton (*Fusarium vasinfectum*). First symptom is yellowing of the lower leaves, followed by wilting and finally by the death of the plant.

Leaf Spots

Several fungi can cause spots on okra leaves and pods. The most common one in Louisiana is a species of *Cercospora.*

Control: The leaf-spotting diseases of okra are not serious enough to justify control measures.

Root Knot

(See page 4.)

ONION[5] AND GARLIC

Some onion diseases (smut, for example) which are destructive in other parts of the country either do not occur or are of minor economic importance in our State. On the other hand, some diseases that are of no importance in the North are very destructive in Louisiana and in the South in general. The diseases which attack onions and garlic in Louisiana are extremely difficult to control. In fact, diseases constitute the chief factor limiting the development of an extensive onion-growing industry in the State.

Downy Mildew (Blight)

(*Peronospora destructor*)

Symptoms: Leaves first become pale green, then turn yellow, and finally collapse and shrivel. Seed stalks are also affected. The plant is not completely killed, but the destruction of the top growth causes the bulbs to be small. Mildew is especially destructive to onions used for production of seed, as mildewed stalks usually fall over before the seed is mature.

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[5] For information on the culture of onions and shallots, see "Horticultural Hints," Vol. 1, No. 7, and Extension Circular No. 242. These publications may be obtained free by writing to the Louisiana Agricultural Extension Department.

Cause: The disease is caused by a fungus (*Peronospora destructor*). The fungus carries over from season to season in many ways—in the seed, in the bulbs, and in the soil. Development and spread of the fungus are favored by cool, humid weather.

Control: Control of mildew is extremely difficult. Since the fungus can survive from one season to the next in so many different ways (in the seed, bulbs, and soil) control or eradication by sanitary measures is practically impossible. Spraying has been tried in the past, both in Louisiana and in other onion-growing states, but it has not proved very satisfactory. To obtain good control it is necessary to keep the new growth covered with spray material as soon as it develops. This means spraying at least once a week for several months. Obviously such a procedure is economically impractical.

Pink Root

Pink root is another serious disease of shallots, onions, and garlic. The disease is caused by a fungus (*Phoma terrestris*) which lives in the soil.

Symptoms: The most characteristic symptom is the pink color of the roots. In addition to the pink color, the affected roots become soft, limp, and finally rot. The plants have an unhealthy, unthrifty appearance, pale green color, more or less stunted growth, and a die-back of the leaf tips. As these above-ground symptoms may be brought about by other conditions, the only sure way of knowing whether or not plants have the pink root disease is to examine the roots.

Control: Control of pink root is a very difficult problem. Once a field becomes infested, the pink root fungus can survive in the soil for many years, even if no onions or garlic are planted, and so rotation is of a doubtful value as a control measure. Furthermore, the fungus is carried over on infected bulbs and sets, and its presence on the dried bulbs and sets is not easy to detect. By the use of diseased sets, the disease is unwittingly spread to new fields. It is possible that varieties resistant to pink root will be developed eventually. Until this has been accomplished the only control measure that may be suggested is prevention. Do not plant onions, shallots, or garlic in fields that are known to be infested. Whenever possible, make sure that the sets you plant have come from disease-free fields. Plant onion seed on new soil or in soil which is not infested with the pink root fungus. This precaution is very important. If the seed is sown on infested soil, the seedlings will become infested and the disease will be spread to areas in which these seedlings are transplanted.

Black Stalk Rot

This is primarily a disease of the seed stalks and is of importance only when onions are grown for seed. It is caused by a fungus (*Macrosporium parasiticum*) which grows on the stalks (and also on the leaves), causing them to rot and fall over before the seed is mature. Affected parts of the stalks become covered with black masses which are made up of the spores of the fungus. The black stalk-rot fungus is not an aggressive parasite, and usually attacks plants which have been weakened by mildew or in some other way.

No satisfactory control measure has been found for this disease.

White Rot

This disease, which was found in Louisiana for the first time in 1942, is included here not because it is of economic importance at present, but because it is potentially a very serious disease of onions, shallots, and garlic, and should be brought to the attention of growers so as to have them on the lookout for it in case it appears in their fields. In this way it can be caught before it spreads. White rot (caused by the fungus *Sclerotium cepivorum*) is a serious disease of onion and garlic in Europe. In the United States the disease has been found previously in localized areas in Kentucky, Virginia, Oregon, California and New Jersey.

Symptoms: The roots and the bases of the scales rot. A white fluffy growth (the "mycelium" of the fungus) and small, spherical, black bodies ("sclerotia") occur on the surface of the bulbs (Fig. 8). Affected plants may wilt and die rather suddenly, or may persist in a sickly, unthrifty condition.

Control: Prevention is the only effective control measure for this disease. Once the soil becomes infested, it remains so for many years because the fungus can survive in the soil even when onions or garlic are not planted. Care, therefore, should be taken to use only healthy sets or transplants. The white rot fungus thrives in cool weather and since onions in Louisiana are grown during the cool months of the year this disease is a potential menace and care should be taken to prevent its spread.

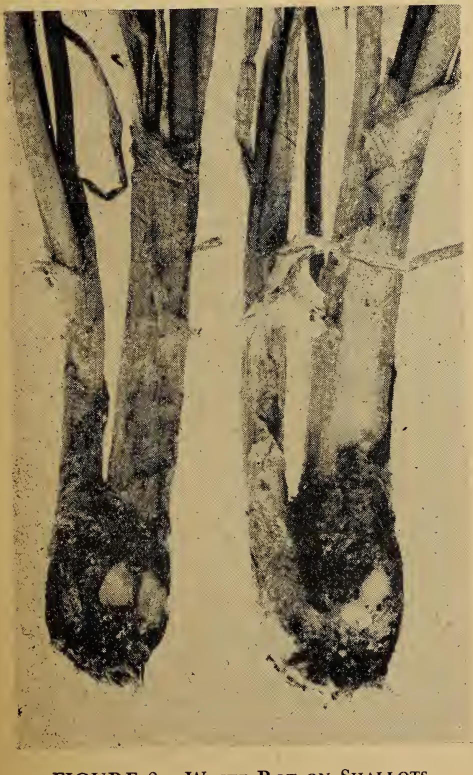

FIGURE 8.—White Rot on Shallots.

Yellows[6]

This disease is mentioned here not because it is important but because it is so striking in its appearance that it is easily noticed in the field and may arouse curiosity or concern. The disease has been seen on shallots and the Creole onion. The leaves of affected plants are so strikingly bright yellow that such plants can be easily noticed from a distance. The plants are stunted in growth and the bulbs are small, soft, and flaccid. If harvested, affected bulbs or sets usually shrivel and dry up in storage. This is fortunate, for the disease is thus self-eliminating.

The cause of yellows is not known. Its symptoms suggest that it is a virus disease but attempts to transmit it by means of juice inoculation have failed. It is possible that it is transmitted by means of an insect vector.

Storage Rots

Decay of onions and garlic in storage or in transit is caused by a large number of fungi and bacteria, such as species of *Botrytis* (neck rot), *Fusarium* (dry rot), *Aspergillus* (black mold), *Macrosporium, Colletotrichum* (smudge), bacteria (soft rot), and many others. White onions are more susceptible to storage rots than those with colored skins. Our Creole onion is a good keeper, and shows considerable resistance to many of the storage rots.

Control of storage rots: All organisms causing storage rots require moisture for their development. Control of storage rots, therefore, is based on proper curing and storage. Many of the storage rots start in the field about harvest time and continue their development in storage. If dry weather prevails during the period of harvesting so as to allow drying and curing, losses from subsequent storage rots will be small. On the other hand, if rains prevail during the period of harvesting and curing, losses from storage rots are to be expected. Curing by the use of artificial heat is very helpful, but facilities for artificial curing are not always available.

To summarize, storage rots are kept in check by proper curing and storing in a cool, well-ventilated storage house.

PEA (GARDEN AND SWEET)

Damping-Off and Root Rots

Peas, both the edible (English) and those used for their flowers (flowering sweat peas), are attacked by a large number of soil-inhabiting fungi which cause the roots to rot. In this popular bulletin it is considered unnecessary to name and describe the various root-decaying fungi. It is enough to state that at least seven different soil-inhabiting fungi are known to cause root rots in peas.

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[6] This disease should not be confused with Yellow Dwarf, a virus disease of onions which occurs in some of the northern states. As far as known, yellow dwarf does not occur in Louisiana.

Root troubles may manifest themselves in different ways: (1) The seed may rot without germinating, or the little seedlings may rot before coming out of the ground (pre-emergence damping-off). (2) The emerged seedlings may be killed gradually. (3) The older plants may show an unthrifty, unhealthy kind of growth, pale green color, stunting, wilting, and gradual dying. If such plants are examined it will be found that their underground parts will show various degrees of decay.

Control: Root rots are difficult to control. Most root rotting fungi live in the soil. Others are seed-borne. Soil and moisture conditions also influence the severity of root rots. No single control measure for root rot can be offered. However, the following measures are suggested as of value for keeping injury from root rots to a minimum:

1. *Seed treatment:* Treat the seed with Cuprocide (see page 87). This treatment controls pre-emergence damping-off and insures a good stand.
2. *Source of seed:* Use western-grown seed when available. Western-grown seed is not only free of some of the root and foot-rotting organisms, but also of those of bacterial blight and Ascochyta blight.
3. *Rotation*: Rotation is very helpful. If enough land is available it is advisable not to plant peas on the same ground any often than once in 4 years.
4. *Resistant varieties:* The "Creole" pea, which in recent years has been grown extensively in home gardens throughout the State, is relatively resistant to root rots. It is also fairly tolerant to mildew. Unfortunately, the Creole is a rather poor quality pea.
5. *Soil moisture:* Plant peas only on well-drained ground. Root rots are decidedly more destructive in poorly drained soils.

Ascochyta Blight

Three species of the fungus known as *Ascochyta* are involved in this blight. These cause purplish to tan-brown, irregular to round, often sunken spots on the leaves and pods (Fig. 9, A) and elongate lesions on the stems. When stem lesions occur near the ground a foot rot is produced which kills the plants.

Control: Since the fungi causing this disease are seed-borne, good control has been obtained by planting blight-free seed on land on which peas were not growing the previous year. That is, control of blight is based on a combination of disease-free seed and rotation. Western-grown seed is usually free of blight. If local seed is used, it should be saved only from healthy plants.

Bacterial Blight

A second blight which very commonly becomes destructive on peas in Louisiana is that caused by bacteria (*Pseudomonas pisi*).

Symptoms: Numerous watersoaked spots on leaves, stems, and pods (Fig. 9, B). Later the spots turn brown in color. Heavily diseased plants may wilt.

Control: Use blight-free seed. Seed grown in the semi-arid western states is usually blight-free.

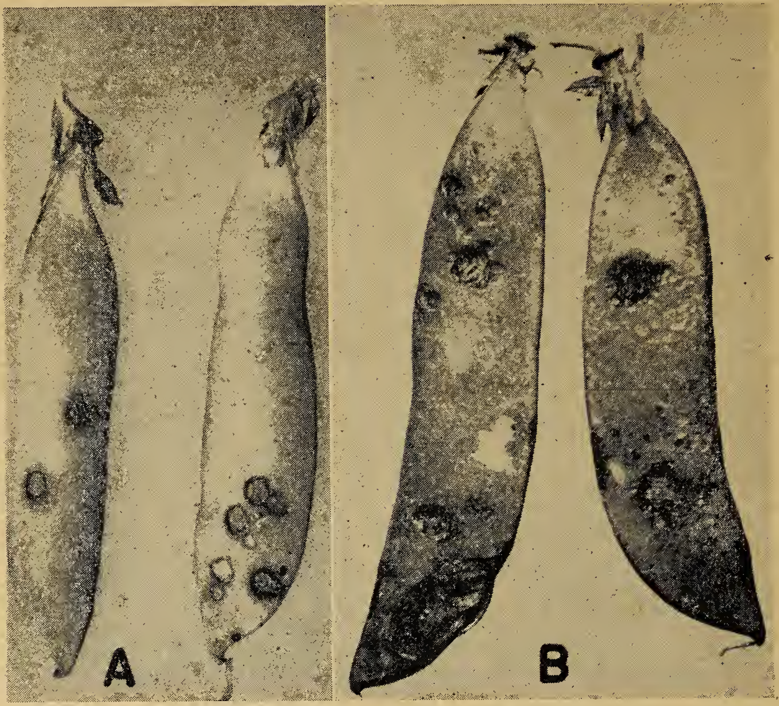

FIGURE 9.—Pod Blights of Peas. A. Ascochyta Blight. B. Bacterial Blight.

Powdery Mildew

(*Erysiphe polygoni*)

Powdery mildew is easily recognized by the whitish, powdery growth on the upper surface of leaves and stems. After some time affected leaves shrivel and fall off.

Control: Powdery mildew usually occurs late in the season after the crop is nearly over, and it is doubtful that control measures are justifiable. However, powdery mildew can be easily controlled by dusting with sulphur. It is advisable to dust as soon as mildew appears before any damage is done. A second application of sulphur may be necessary if mildew persists.

Anthracnose

Anthracnose, caused by a fungus (*Colletotrichum pisi*), is of no importance on English peas in Louisiana but it is often very destructive on flowering sweet peas. It causes irregular, brown dead spots on leaves and flowers and elongated dead areas on stems and flower stalks.

The disease is favored by cool, moist weather. It often becomes very destructive on sweet peas during April if cool, rainy weather prevails.

No satisfactory control is known for this disease.

PEANUT

In the past the peanut acreage in Louisiana has been limited. Only in two relatively small areas in Caddo and Rapides parishes have peanuts been grown on a commercial scale. The rest of the plantings have been small patches for home use. Under these conditions peanut diseases have been of minor importance. However, under the stimulus of the farm food production program the peanut acreage in the State was markedly increased in 1942 and a still larger increase is expected in later years. With the increase in acreage, disease control becomes important.

Leaf Spot

(*Mycosphaerella arachidicola* and *M. Berkeleyii*)

Description: The most important disease of peanuts is the leaf spot which is caused by two species of the fungus *Mycosphaerella.* The spots on the leaves are brownish to black with light-colored margins and circular to irregular in outline. On the stems and leaf stalks, the spots are elongated. The disease causes the leaves to shed before the crop is ready to harvest and this premature defoliation results in low yields of both nuts and hay.

Control: Leaf spots can be effectively controlled by dusting about 3 times with 325 mesh sulphur. The first dusting should be made about the first week of July (60-65 days after planting). The other two applications should be made at intervals of about two weeks. If it rains heavily within 24 hours after dusting, a fourth application is advisable. A dust mixture made up of 9 parts of 325 mesh sulphur and 1 part basic copper sulphate has given slightly better control than sulphur alone.

In tests made in Caddo Parish in 1941 the sulphur dusted plots yielded about 40 per cent more nuts and about 32 per cent more hay than those that were not dusted. Similar results have been obtained in other states. So it is evident that it pays to control this disease.

Southern Blight

(*Sclerotium rolfsii*)

This fungus which attacks many different kinds of plants (see PEPPER, page 30) sometimes causes stem and pod rot.

Control: Rotate. Do not plant peanuts on the same land on which the disease occurred the previous year.

PEPPER

Damping-Off

(Caused by several soil fungi)

Description: See page 84.

Control: By treating the seed with copper oxide (Cuprocide) better germination and better stand of seedlings are obtained. Add 2 level teaspoonfuls of Cuprocide to each pound of seed in a closed container, shake until the seed is well covered, then screen to remove any surplus dust that has not adhered to the seed.

This treatment is usually sufficient to insure good germination and to prevent damping-off of the seedlings after germination. If the seed has not been treated, or if plants continue to damp off in spite of seed treatment, water the plants with a suspension made with 1¼ oz. of Cuprocide per gallon of water. One watering usually is enough, though a second will not be harmful.

Bacterial Spot

(Bacterium vesicatorium)

Description: This disease occurs both in the seed bed and in the field. It forms spots on leaves and fruit. On the leaves, the spots are at first raised and wart-like but soon the tissues dry out, leaving small, dark-brown, more or less angular spots (Fig. 10). Spotted leaves soon turn yellow and shed, resulting in defoliation and stunting of the plant. Severely defoliated plants set very little fruit, which is usually of unmarketable quality. On the fruit, the spots are raised, wart-like.

Control: The disease is seed-borne. The bacteria causing the disease are carried on the surface of the seed and they are known to remain viable for at least a year. It is suspected that the bacteria may live over in the old plants in the field, but this has not been proved experimental-

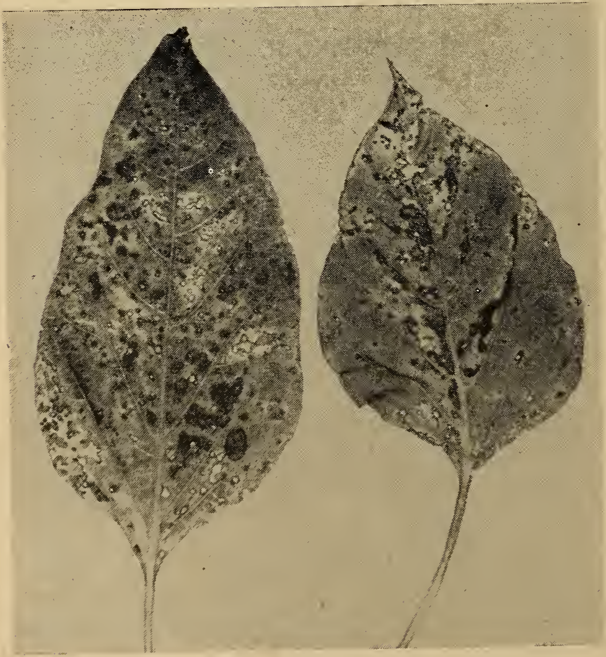

FIGURE 10.—Bacterial Leaf Spot of Pepper.

ly. Under cultural practices prevailing in the sweet pepper growing districts of Louisiana, where the plants are plowed under as soon as the crop is harvested in early summer, it is very doubtful that the bacteria survive in the soil from one year to the next. So far as sweet peppers are concerned the control of bacterial spot is best accomplished by disinfecting the seed. Cuprocide, which is recommended for the control of damping off, unfortunately does not control bacterial spot. A more drastic method is necessary. Of several treatments recommended by different pathologists, the three most promising ones are given here:

A. *The corrosive sublimate treatment:* Soak the seed in a 1-1000 solution of corrosive sublimate (see "black rot of cabbage" for directions for making the solution) for 5 to 6 minutes, wash thoroughly in running water (or in several changes of water), and either plant directly while still wet or spread out to dry. It is better to dry the seed after this treatment, for then it can be dusted with red pepper oxide (Cuprocide) for the control of damping-off. While the corrosive sublimate treatment is very effective, it is also risky and should be used with care. Pepper seed is sensitive to corrosive sublimate and may be injured somewhat under certain conditions.

B. *The Semesan treatment:* Dissolve 1 oz. of Semesan in 3 gallons of water. Soak the seed in this solution for 1 to 1½ hours, drain, and spread out to dry. This treatment will also control the pre-emergence phase of damping-off (see page 84).

C. *The copper sulphate treatment:* Soak the seed in water 6 to 12 hours (or overnight), drain off the water, then place the seed in a copper sulphate (bluestone) solution made by dissolving 1 oz. of copper sulphate in 2 quarts of water. Soak the seed in the copper sulphate solution for 5 minutes, drain, then roll the seed in hydrated lime and plant immediately after treatment. This treatment will also control the pre-emergence phase of damping-off.

In recent years seed dealers have been treating their seed, and pepper seed sold to growers is usually labeled "treated for diseases." This is a step in the right direction, for the seedsman is better equipped to do the job than the average grower. However, since one particular treatment is not effective against all diseases, it is well for the grower to ascertain for what particular disease the seed he buys has been treated.

Some growers follow the practice of planting a few tomato seeds in the pepper plant bed for transplanting later in the home garden. This should not be done because the same bacteria which cause pepper blight infect tomatoes also, and tomato seed is often infected. A single infected tomato plant is enough to spread the blight over the entire plant bed.

Cercospora Leaf Spot (Leaf Drop)

(*Cercospora capsici*)

Description: This disease is distinguished from the bacterial leaf spot by the large, circular to oblong spots with grayish centers and dark brown margins (Fig. 11). Spotted leaves turn yellow and drop off, hence the common name "leaf drop." The damage is caused by the defoliation of the plant. Spots develop also on the stems of the plant and on the fruit.

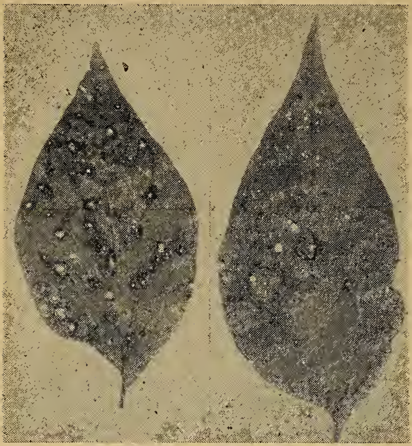

FIGURE II.—CERCOSPORA LEAF SPOT OF PEPPER.

The disease appears in the field usually about the middle of May, and if conditions are favorable (hot, wet weather), the plants may become badly defoliated in 2 or 3 weeks. The disease apparently is not seedborne. We have been unable to obtain the fungus from the seed and we have never found the disease in the seed-bed, although a careful search for it has been made. On the other hand, we have found the fungus fruiting profusely in the spring on infected pepper stems and leaves which had overwintered outdoors. So it appears that, under Louisiana conditions, the leaf drop fungus is carried over from one season to the next on infected pepper refuse.

Control: The disease can be controlled by spraying with 4-4-50 Bordeaux mixture (or with some other copper spray). We have obtained good control by spraying with 4-4-50 Bordeaux and also with "Spraycop," at the rate of 3 lbs. in 50 gallons of water.

Even though spraying is effective in controlling this disease, it is still a question whether or not it pays to spray. The disease becomes progressively worse as summer advances. If the harvesting season is long, it will undoubtedly pay to spray, and the length of the harvesting season is conditioned by the market price for peppers. During the past few years the price of peppers dropped by the end of June to the point where it did not pay to pick. Under these conditions it is questionable whether spraying for the control of this disease would be economically practicable.

Southern Wilt (Southern Blight)

This disease is caused by a soil-inhabiting fungus known by the technical name of *Sclerotium rolfsii.* The fungus is a warm climate organism and is common in the Southern States. It attacks a very large number of different plants during the hot summer months. The fungus attacks the plant at the ground line, girdling and causing it to wilt and die rather suddenly. The disease is easily recognized by the white weblike growth of the fungus and the numerous creamy-white to brown seedlike bodies (sclerotia) which are found on the girdled part of the stem and on the ground. The sclerotia are about the size, shape, and color of mustard seed. These bodies remain viable in the soil and carry the fungus over from one season to the next.

No control is known for this disease. Fortunately it is a minor disease. Occasionally it may cause the death of a considerable number of pepper plants in some fields, but in general it is a disease of small importance.

Mosaic

(*Virus*)

Description: The symptoms of mosaic vary considerably (there are different strains of mosaic) but in general they consist of mottling (green and yellow color) and distortion (puckering, twisting malformation) of the leaves and general stunting of the entire plant. If the plant becomes infected when young it is entirely worthless; it remains stunted and either sheds its blossoms or, if it sets any fruit, it is small and misshapen. If infection occurs after the plant has reached maturity the damage is decidedly less.

Control: Mosaic is very infectious. It is spread principally by plant lice, but also by other insects and by handling, such as transplanting and picking. Once the plant becomes infected, there is no cure. Control, therefore, is based on preventing infection. The plants in the seed bed should be sprayed often with nicotine to kill the aphids. In the field, diseased plants should be destroyed as soon as they appear to keep the disease from spreading.

IRISH POTATO

The Irish potato is affected by a very large number of diseases. Fortunately, control measures have been worked out for most of these diseases. Furthermore, climatic conditions play an important role in the distribution and severity of some diseases, and so it happens that one of the most serious diseases of the potato—late blight—seldom occurs in Louisiana. Most potato diseases are "seed-borne," that is, they are carried over on or in the tubers. For this reason, the planting of certified seed is the best preventive measure against disease of the potato. Certified seed, however, is not a "cure-all." Some disease producing organisms are soil-borne, and others are carried over on other plants which are related to the potato, such as tomato, eggplant, pepper and many weeds. In this bulletin, the potato diseases which commonly occur in the State, or are likely to occur, are briefly described and recommendations for their control or prevention are given.[7]

Common Scab

(*Actinomyces scabies*)

Description: Scab affects only the tubers (Fig. 12). It forms round to irregular, hard, corky areas on the tubers. Scabby spots may be small and solitary or large and fusing together to cover most of the surface of the tuber. The scab organism is both seed and soil-borne. It likes neutral to alkaline soils. Scab is not a problem in acid soils.

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[7] For a more detailed description of potato diseases and their control see U. S. Department of Agriculture Farmers' Bulletin Nos. 1881 and 1904.

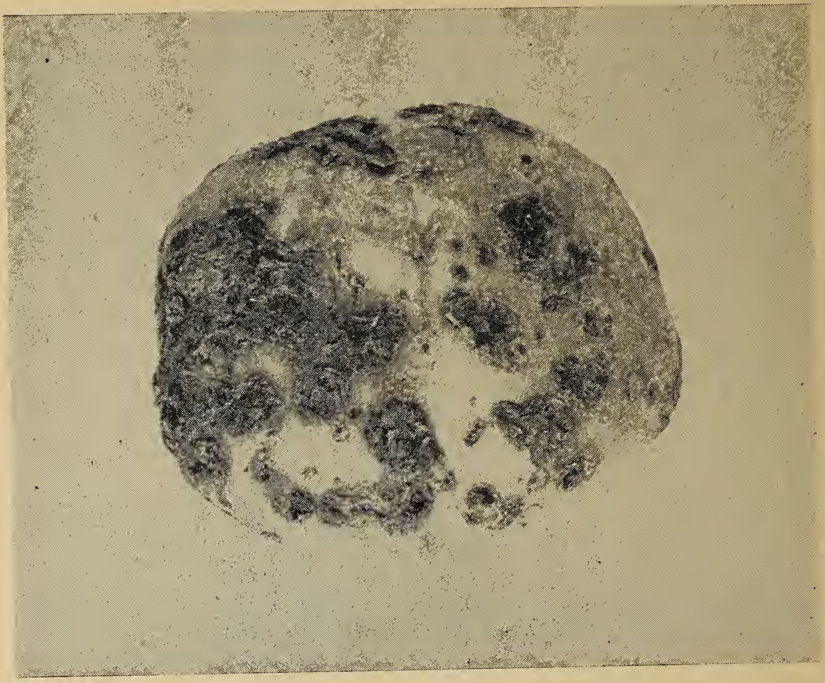

FIGURE 12.—SCAB OF POTATO.

Control: Treat the seed with either of the following disinfectants: (1) Hot formaldehyde (page 88). This method has been in use in Louisiana for several years and has proven its usefulness. (2) Acidified mercuric chloride (page 85).

Black Scurf

(*Rhizoctonia solani*)

Scurf affects both tubers and stems. On the tubers it forms hard, black bodies (sclerotia) which adhere tightly to the skin. When the tubers with scurf sclerotia on them are planted, the scurf fungus (*Rhizoctonia*) grows and attacks the new shoots, forming cankers on the stems and stolons and finally on the new tubers.

Control: Same as for "scab" (pages 88 and 85).

Since both scab and the scurf organisms can live over in the soil, seed disinfection does not give 100 per cent control. However, seed disinfection is a great help in reducing infection with both these diseases and its practice is strongly recommended. Crop rotation is recommended for reducing soil infection.

Brown Rot (Bacterial Wilt)

(*Phytomonas solanacearum*)

Symptoms: The first manifestation of the disease is a slight wilting of the plant during the hottest period of the day. The plant recovers at night but wilts again the next day and the wilting becomes progressively worse until the plant dies. At first there is a brown discoloration in the inside of stems and roots (in the vascular bundles), but later the brown color appears externally. The same is true of the tuber. In the early stages the brown discoloration is internal—around the vascular bundles—but later the brown color appears on the outside of the tuber, especially about the eyes. Finally the tubers rot.

Control: Brown rot does not occur in the northern states where potato seed is grown, so the disease cannot be avoided by the use of certified seed; the disease is limited to the southern states. The bacteria causing brown rot can survive in the soil (particularly in sandy soils) for long periods, and they also attack many other cultivated plants and weeds. This makes it very difficult to try to eliminate the disease from potato-growing land. In Florida where brown rot has been very severe in certain areas, good control has been obtained by applying sulphur to the land in the summer (800 lbs. per acre), followed by liming in the fall (3000 lbs. per acre). In Louisiana brown rot has not been of sufficient economic importance to justify such a drastic and costly method of control.

Ring Rot

(*Phytomonas sepedonica*)

Ring rot also is caused by bacteria (a different species from that causing brown rot). The field symptoms of ring rot and brown rot are similar to the extent that both diseases cause wilting of the plants. They vary, however, in many other respects. Ring rot does not cause a brown discoloration of the stem; brown rot does. Ring rot causes cracking of the tubers and a reddish-brown discoloration of the skin of the tubers; brown rot produces a dark-brown to black discoloration of the tissue of the tuber, with no trace of red color and no cracking.

Control: Unlike brown rot, the ring rot disease is not limited to the South, but occurs in practically all the potato-growing regions of the country. Fortunately, the ring rot bacteria apparently do not survive in the soil from one season to the next. The disease is carried over in slightly infected tubers which do not show external symptoms and may therefore be overlooked by the seed inspector. The bacteria are very infectious and the disease can easily be spread from the few infected tubers by the knife during the process of cutting seed potatoes for planting. In spite of this difficulty, the use of certified seed helps to keep losses from ring rot to a minimum. Seed-producing states are very strict regarding this disease. They will not certify any field that shows even a trace of ring rot, and the only way that the disease can get by is in slightly infected tubers which show no external symptoms and thereby escape detection. Furthermore, Louisiana allows no tolerance for ring rot in certified seed that enters the State. If any trace of ring rot is found in a lot of seed shipped into the State, certification tags are removed, and the lot cannot be sold as certified seed. In this way the grower is protected, to a great extent, against this serious potato disease.

Early Blight

(*Alternaria solani*)

Description: This disease is caused by the same (or closely related) fungus which causes leaf blight of tomatoes (see page 43). It forms brown, dead spots on the leaves. When the spots are numerous they run together and kill large portions of the leaves, thereby causing a reduction in the yield of potatoes. Early blight makes its appearance usually toward the latter part of April. The disease is influenced by weather conditions; wet, warm weather favors its development.

Control: Early blight can be controlled by spraying with Bordeaux 4-4-50 or some of the other copper sprays. Copper dusts are also effective. It is a question, however, whether or not it is economically profitable to spray for this disease. The severity of the disease and the price of potatoes in any particular year are the chief factors to be considered. In tests made by this department, markedly increased yields were obtained by spraying in 2 out of 3 years. In one year, when the disease was very light, the sprayed plants actually yielded less than the unsprayed. In general, it is not profitable to spray for this disease.

The blight fungus passes the winter on infected plant parts left in the field. For this reason it is not a wise practice to have a spring crop of potatoes in the same field in which a fall crop of potatoes or tomatoes was grown the previous year.

Late Blight

(*Phytophthora infestans*)

Late blight is another fungus disease. It is the most destructive potato disease in the northeastern States. It is called "late blight" because in the North the disease occurs in late summer. In Louisiana, however, when the disease occurs it appears early in the season—earlier than the "early blight." Fortunately, the disease occurs very rarely in Louisiana. It is a cool, wet weather disease, and so it appears in Louisiana only when unseasonable, cool, wet weather prevails during April.

The late blight fungus is carried in diseased tubers. Certified seed produced in the relatively dry northwestern States is usually (but not always) free of infection. On the other hand, seed grown in the more humid States bordering the Great Lakes and eastward usually contains some infected tubers in spite of rigid inspections.

Description: The blight usually appears first as water-soaked spots on the margins of the lower leaves. These spots enlarge rapidly and soon the entire leaf is killed (Fig 13). A whitish, downy, fungus growth can usually be seen on the under surface of the affected areas of the leaves. If weather conditions are favorable (high humidity and cool temperature), the blight spreads very rapidly and all the plants in a field may be killed in a few days. The blight fungus can also attack the tubers. Affected tubers show reddish-brown areas when cut. Blight-infected tubers may rot in the soil or in storage.

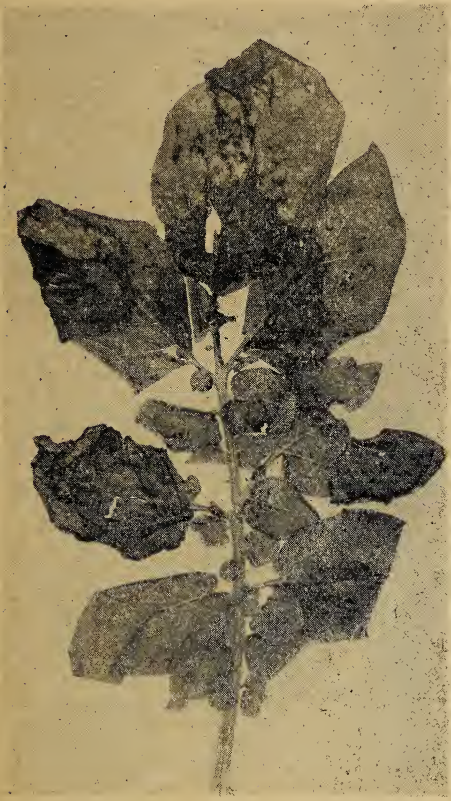

FIGURE 13.—LATE BLIGHT OF POTATO.

Control: Although late blight rarely occurs in Louisiana, it is potentially such a serious and destructive disease that it is well for the grower to be on the alert for it, especially if the seed he has planted has come from a region where the blight is known to occur. It takes only a few infected tubers in a field to start an outbreak of blight if weather conditions are favorable. The blight can be effectively controlled by spraying with 4-4-50 Bordeaux mixture or with some other copper sprays (see page 89).

Leaf Roll

(*Virus*)

Description: Leaf roll is one of the many virus diseases (see page 5) of the potato. The virus is carried over in tubers of diseased plants and the disease is spread very rapidly by aphids. The most prominent symptom of leaf roll is the pronounced upward rolling of the leaflets. Other symptoms are stunting of the plant, stiff, leathery texture of the leaves, chlorosis, purplish discoloration of some leaves, and reduction in yield.

Control: Since leaf roll is carried over in infected tubers, the obvious way to control the disease is to prevent it by planting disease-free seed. Plant only certified seed. Seed-producing states have strict rules in respect to seed certification in order to keep virus and other seed-borne diseases to a minimum. The tolerance for leaf roll permitted by Louisiana is only 2.0 per cent.

Mosaic

(*Virus*)

Mosaic is another virus disease. There are several strains of mosaic, differentiated by the symptoms they produce on the plant. Two of the common strains are treated here, namely, "mild mosaic" and "rugose mosaic."

Mild mosaic is characterized by mottling—scattered yellowish areas on the green leaf—and by slight crinkling of the leaves. This is a relatively mild disease.

Rugose mosaic is a much more serious disease than mild mosaic. There is mottling of the leaves as in mild mosaic and the crinkling of the leaves is very pronounced (Fig. 14). Affected plants are decidedly stunted and die earlier than the healthy ones. Losses from rugose mosaic may run as high as 60 to 75 per cent.

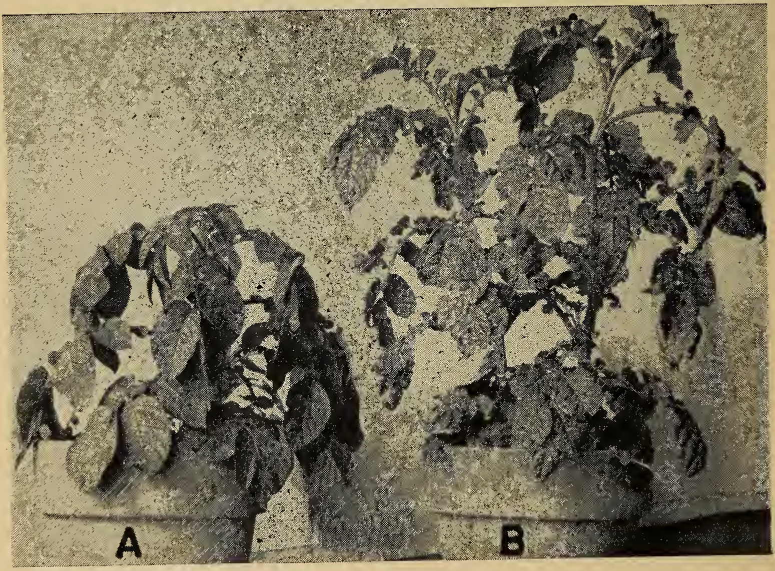

FIGURE 14.—RUGOSE MOSAIC OF POTATO. A. HEALTHY PLANT. B. PLANT AFFECTED WITH RUGOSE MOSAIC.

Control: Same as for leaf roll. Plant certified seed. The tolerance permitted by Louisiana in certified seed are 2 per cent for rugose and 5 per cent for mild mosaic. Of the two principal varieties grown in Louisiana, the Kathahdin is resistant to mild mosaic.

Haywire

This disease is of very minor importance but because of the very striking appearance of affected plants in the field it is mentioned here.

Symptoms: There is a delayed emergence of plants from diseased tubers. The plants are severely stunted; the foliage is stiff, brittle, rolled, pointed, and yellowish with purplish discoloration at the tips and margins. Aerial tubers sometimes are formed at the leaf axils. Very few tubers are produced.

The cause of haywire is not definitely known. It is believed that it is a virus disease. Infected plants are worthless and should be removed.

Root Knot

(*Heterodera marioni*)

The potato is one of many crop plants that are affected by the root knot (gall) nematodes. Swellings or galls form on the roots and tubers. Infected tubers have a knotty, bumpy surface.

The root knot disease is of relatively minor importance. Losses from it are slight, especially on the spring crop which is grown during the cool season. However, care should be taken not to use infected tubers for seed, for that is a very effective way of spreading the nematodes to new fields.

SPINACH

In the past, spinach has been grown in Louisiana only in isolated patches in home gardens, and under these conditions diseases on the crop have not been a problem. In recent years, however, commercial growing of spinach for canning, quick-freezing and dehydrating has come into use, and the acreage devoted to this crop has been on the increase. Judging by what happens in other spinach-growing regions, and also by past experiences when attempts were made to grow spinach on a large scale in this State, diseases in commercial spinach fields are to be expected. It is for this reason that some of the diseases of this crop are included here.

Damping-Off

(*Caused by several soil fungi*)

Spinach seed responds very favorably to treatment. Better germination, better stand, and less post-emergence damping-off of seedlings are obtained if the seed is treated. The seed may be treated either with Cuprocide (see page 87), or with Vasco 4 (see page 88).

Downy Mildew

(*Peronospora effusa*)

Symptoms: Yellowish spots on the upper surface of the leaves and a bluish moldy growth on the under surface of the spots. Later the entire leaf may be killed.

Control: This disease is difficult to control. It can be controlled by copper sprays and dusts, but these leave objectionable residues on the leaves which detract from the market value of the crop. If sprays or dusts are used, applications should stop at least 10 days before harvesting.

White Rust

(*Albugo occidentalis*)

White blister-like spots mostly on the undersides of the leaves. The leaf areas surrounding the spots turn yellow. This is a new disease which appeared in the Winter Garden area of Texas a few years ago, and in some years it has been very destructive. No satisfactory control is known. Thus far, white rust has not been found on spinach in Louisiana.

SWEET POTATO[8]

Black Rot

(*Ceratostomella fimbriata*)

Description: Black rot is a field, storage, and seed-bed disease, the greatest losses occurring in storage. The disease attacks all under-ground parts of the plant. The most conspicuous spots are found on the mature potato; appearing as dark circular to irregular areas varying in size from very small to those which may cover a large part of the potato (Fig. 15). The spots are somewhat depressed and greenish-black in color. The diseased portion of the potato is bitter in taste, and in cooking this bitter taste spreads throughout the entire potato.

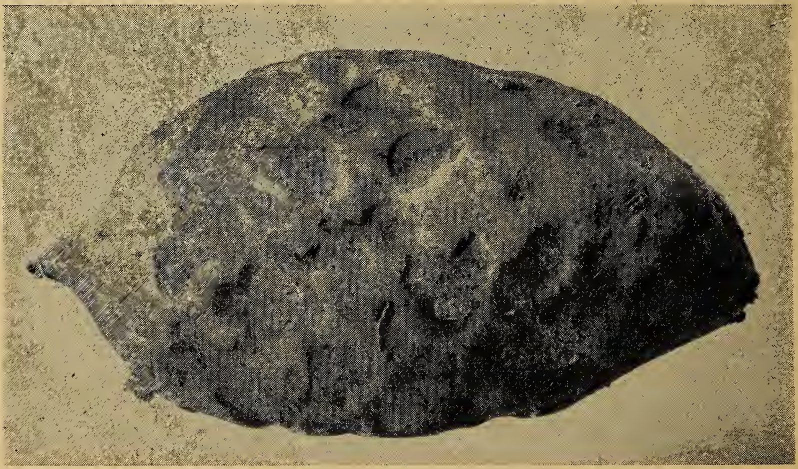

FIGURE 15.—Black Rot of Sweet Potato.

In the bedded potatoes, black spots may occur on the young sprouts. If the sprouts are infected early the stems may be girdled and the plants become dwarfed and yellow.

In the storage house the disease is spread by spores of the disease organism that are produced in small black bodies (perithecia) found near the center of the black rot spots.

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[8] The section on sweet potato diseases was written by Dr. L. H. Person.

Control: The best method of control is by the use of clean seed potatoes. Clean seed can be obtained by grading out at digging time all potatoes that show any type of rot. This operation should be repeated again in the spring before the potatoes are bedded. If a large number of black rot potatoes are found, it is advisable to discard the old seed and obtain the best possible certified seed. Seed treatment should be practiced if black rot is present on potatoes that are to be used for seed. For treating seed potatoes, the mercuric chloride method (see page 85) should be used. The seed certification service of the State Department of Agriculture requires that the mercuric chloride method be used if the potatoes are intended for the production of certified seed or plants.

The organism causing the disease lives over in the soil, so at least a 3-year rotation should be practiced.

Stem Rot (Wilt)

(*Fusarium batatatis and Fusarium hyperoxysporum*)

Description: Stem rot is primarily a field disease, although sometimes it occurs in the seed bed. Diseased plant in the seed bed show a slight yellowing of the leaves, which are also somewhat puckered. Quite often a cluster of plants in the bed shows these symptoms, indicating that they have been produced from a diseased potato. The disease is recognized in the field by a slight yellowing of the leaves. If the plants become diseased soon after being set in the field, or if they are slightly diseased when removed from the seed bed, they are usually somewhat stunted and smaller than the healthy plants. If the cortex (outer covering of the stem) is peeled away the underneath portion of the stem is dark brown in color. This dark brown discoloration may extend several feet into the stem and is the most characteristic symptom of the wilt disease. Sometimes the stems swell and burst near the soil surface, exposing the brown discolored portion of the diseased stem.

Control: This disease is caused by an organism that is capable of living over in the soil for a number of years; therefore, as long a rotation of crops as is practical should be followed—if possible a 4 to 5-year rotation plan.

The disease organism is also carried in the potatoes and this is probably the main way in which the disease is spread from farm to farm. If wilted plants have been seen in the field, seed potatoes should be selected in the fall at digging time. Each hill should be examined by splitting the stems, and potatoes should only be saved for seed from hills which show no discoloration in the stems. The seed potatoes should be stored in clean crates and kept separate from the remainder of the crop. The seed potatoes should be bedded in land which is free from the wilt organism.

At the present time wilt or stem rot is not a serious disease in most of the commercial sweet potato growing area in Louisiana. In northern Louisiana the disease is more serious, due to the fact that the land is more sandy. In the lighter soil types this disease may cause greatly reduced yields when introduced into a field, and every precaution should be taken to keep the disease off the farm. If a new farmer goes into sweet potato growing, he should obtain the best possible certified seed potatoes.

Soil Rot (Pox)

(*Actinomyces ipomoeae*)

Description: Soil rot has been reported from most of the sweet potato growing states, and has become a serious disease in some areas in Louisiana. The disease is recognized in the field by plants failing to grow or vine in definite localized spots. The spots may be small if the disease organism has been present only a short time, or the entire field may be diseased if the disease organism has been present for several years. The plants in the diseased spots remain small and stunted as though conditions were unfavorable for growth. The leaves are pale green to yellow in color, and many of the plants die before the end of the season. The diseased plants are easily lifted from the ground and the root systems are very poorly developed, most of the roots being entirely rotten. The disease is also found on the mature potatoes as pits or scab spots with irregular jagged or roughened margins, varying from small spots to spots more than one inch in diameter (Fig. 16). Sometimes the spots are so numerous that most of the potato is covered. The roughened appearance of the spots is due to the black granular remnants of the old dead tissue. Sometimes the potatoes are rough and badly misshapen. Late in the season the diseased spots in the field can be located by grassy areas which come in where the plants fail to vine and cover the ground.

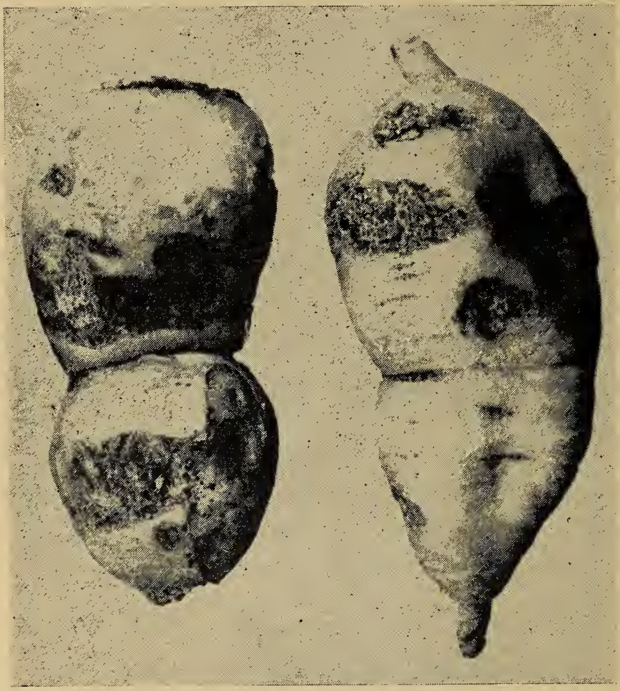

FIGURE 16.—Soil Rot (Pox) of Sweet Potato.

The disease is much more severe in dry seasons, especially when a 2 or 3-week dry period follows immediately after the plants are set in the field, than in seasons when a large amount of rain falls in May, June, and July. In wet or rainy seasons fairly normal yields of potatoes have been obtained in heavily diseased fields. The same diseased fields in dry seasons have been a total loss, the crop not even being harvested as no vine growth developed and the entire fields were overrun by grass and weeds.

Control: The organism causing this disease lives for a number of years in the soil and every precaution should be taken to keep the disease off the farm. Do not bed potatoes that show any roughened or scabby spots. Do everything possible to keep from spreading soil from a diseased spot into other fields where the disease is not present. In dry seasons sulphur added to the soil at the rate of 500 to 700 pounds per acre, 2 to 3 months before the plants are set in the field, has given fairly satisfactory control. In wet seasons sulphur added to diseased fields has not given enough increase in yield to warrant the use of sulphur as a control measure. Experiments now being carried on indicate that the one application of sulphur will be effective for at least 3 years and possibly longer.

Scurf

(*Monilochaetes infuscans*)

Description: Scurf is found on the underground parts of the plant, primarily on the mature potatoes. It is observed as a brownish to brown-black discoloration of the outer skin of the potato. The discolored areas may be in spots or may cover a greater portion of the potato. The spots are only superficial and do not injure the quality of the potato, although they affect the appearance and grade. The disease is most serious in heavy, poorly-drained soils that have an abundance of organic matter.

Control: (1) Use clean seed potatoes, (2) practice rotation, and (3) in heavy soils do not plant potatoes following a heavy cover crop that has been turned under the previous year.

TOMATO

Damping-Off

(*Caused by several soil fungi*)

Description: See page 84.

Control: Treat the seed with Cuprocide (see page 87 for method of seed treatment).

Fusarium Wilt

(*Fusarium lycopersici*)

Description: This is by far the most serious tomato disease in the southern states. The disease is caused by a soil-inhabiting fungus which penetrates the roots of the plant and grows upward into the vascular bundles of the stem and leaves, causing the plant to wilt and eventually to die (Fig. 17). The lower leaves are the first to show the symptoms. They wilt, turn yellow, and die. The disease progresses upward gradually until the entire plant is killed. Dark brown discoloration of the inside tissue of the stems and leaf stalks is a characteristic symptom.

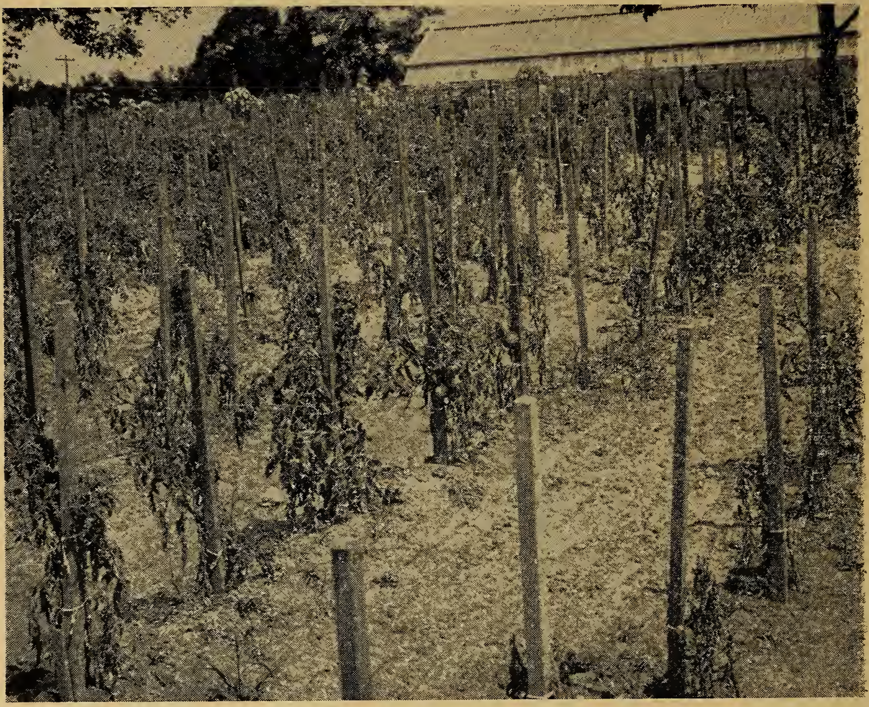

FIGURE 17.—TOMATO FIELD SEVERELY INFECTED WITH FUSARIUM WILT.

Control of wilt: The only effective way to control tomato wilt is to grow wilt-resistant varieties. There are several varieties which are resistant to wilt and which are well adapted to Louisiana growing conditions. At present, the following tomato varieties are most commonly grown in Louisiana: Gulf State Market, Louisiana Gulf State, Dixie, Rutgers, Prichard, Marglobe, and Louisiana Pink. Of these the Marglobe and the Louisiana Pink are resistant to Fusarium wilt, the Louisiana Pink being very highly resistant and the Marglobe only moderately so. The other varieties should not be planted in soil known to be wilt-sick.

Unfortunately, it is a well-known fact that quality and wilt-resistance apparently do not go together. None of the wilt-resistant varieties possesses the quality excellence found in the susceptible varieties. On new soil on which tomatoes have never been grown before, one may succeed in growing a particularly desirable wilt-susceptible variety. For the normal run of the field and garden, however, only resistant varieties should be planted to avoid losses from wilt.

Mention should be made here of the new wilt-resistant variety, the "Pan America." This variety, which has been developed recently by workers of the United States Department of Agriculture, is so highly resistant as to be practically immune. It has good quality fruit. The variety has not been completely pure-lined, and so in a planting a few of the plants may be off-type. The Pan America has not been tested sufficiently for yield and other characters in Louisiana, but because of its very high degree of resistance to wilt its planting is recommended.

Bacterial Wilt

(*Phytomonas solanacearum*)

Description: This disease differs in symptoms from the common tomato wilt. The leaves wilt rapidly and the plant dies rather suddenly, instead of slowly from the bottom leaves upward as in the case of the Fusarium (common) wilt. The inside of the stem and leaf stalks may be somewhat discolored, but it is not dark brown to black as with the common wilt. The pith of the stem is usually dark-colored.

Control: No satisfactory control is known for this disease. The wilt bacteria carry over in the soil from one season to the next and there is strong evidence that they are spread over the field by surface water during heavy rains. Furthermore, the bacteria are not limited to the tomato. They attack potato, eggplant, and several weed plants. They are probably carried on or in the seed. Spread from plant to plant by insects is also likely. All these factors make the control of this disease very difficult. There are no resistant varieties known. The only control measure that can be suggested for the disease is sanitation. Tomatoes should not be planted on the same ground on which the disease was present the previous year. Plant on well-drained soil to prevent the spread of the disease by surface water during heavy rains.

Fortunately, bacterial wilt is usually not severe in an average year. There are local outbreaks every year, sometimes very severe. In the spring of 1942, for example, bacterial wilt was very prevalent and very destructive in the vicinity of Baton Rouge. In general, however, the losses from this disease are minor.

Early Blight and Nailhead Spot

(*Alternaria solani*)

There is some disagreement among pathologists as to whether early blight of the tomato leaves and nailhead spots of the tomato fruit are two distinct diseases caused by two closely related fungi, or whether the foliage and fruit symptoms are expressions of one and the same disease. For practical purposes this question is not important, and in this bulletin early blight and nailhead spot will be treated as one disease.

Description: The disease may attack plants at almost any stage of their development, in the cold frame or in the field. However, in what we may term a normal growing season the disease makes its appearance after the plants have been set out in the field, usually about blossom and fruit-setting time. The first sign of the disease is the appearance of small brown spots on the lower leaves. These spots enlarge (Fig. 18), and the leaf gradually turns brown, dries up, and dies. The disease progresses upward, the lower leaves being killed first and later the upper ones. In a badly blighted plant all lower leaves are dead and the upper ones are covered with brown spots of different sizes. Spots also often develop on the stems.

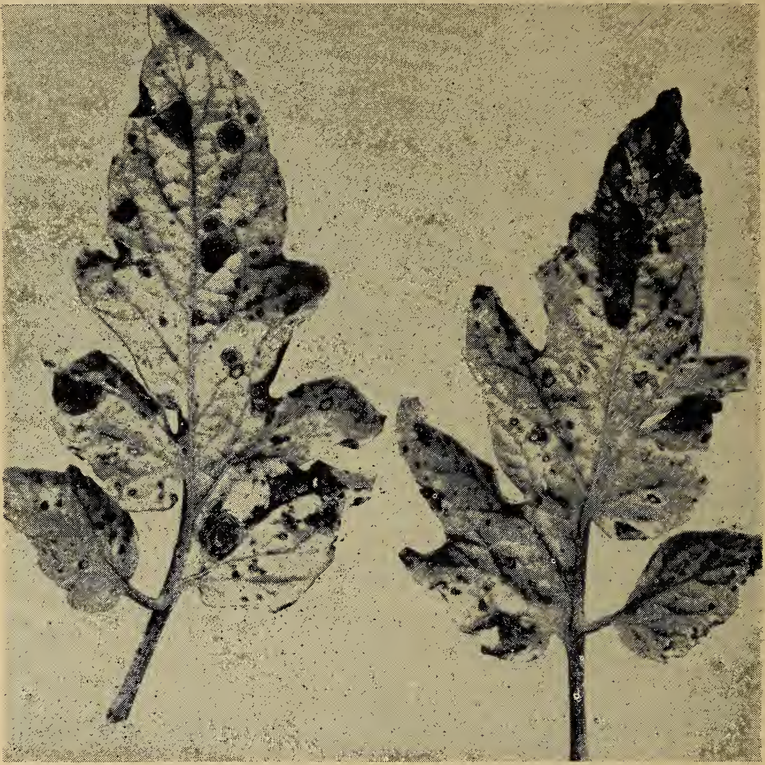

FIGURE 18.—TOMATO LEAVES SPOTTED BY THE ALTERNARIA BLIGHT.

In a normal season spots do not develop on the fruit. If seasonal conditions are favorable for the development of the disease, however, the fruit may become severely spotted. This phase of the disease is called the nailhead spot (also termed "nailhead rust" by some growers). The spots on the fruit appear first as small, shallow, gray or tan specks anywhere on the fruit surface. Later the spots enlarge, becoming grayish-black and sunken. The color of the spots varies somewhat with the age of the fruit, but in general they are sunken, grayish-white in the center, with dark-brown to black borders.

It is the nailhead spot (fruit-spotting) phase of the disease that is most destructive and of the greatest economic importance. Under favorable conditions the fruit will spot not only in the field but also in storage or in transit. Fortunately, the fruit is not affected every year in Louisiana. In fact, the fruit-spotting phase of the disease occurs very seldom in this State.

Control: This disease can be effectively controlled by spraying with copper fungicides, especially with Bordeaux mixture. The question still remains, however, whether or not it pays to spray for this disease. Tests over a period of years, both in Louisiana and in other states, have shown that in a normal year (when the disease was not particularly severe) tomato plants sprayed with Bordeaux actually yielded less than those left unsprayed, even though the spray gave a good control of the disease. The reason for this is that Bordeaux causes a certain amount of injury to tomatoes. Bordeaux causes stunting of the plant, shedding of some of the blossoms, and delayed ripening of the fruit. The delayed ripening of the fruit is especially important in the case of commercial plantings, for the early fruit sells at a higher price. In "bad" disease years (when there is a rapid spread of the blight to the upper leaves and to the fruit) it would certainly pay to spray. The difficulty is that it is not always possible to predict a "bad" disease year. To get around the Bordeaux spray injury, several of the so-called insoluble copper compounds have come into use in recent years. Several of these have proved fairly satisfactory without solving the problem entirely, for those that are not harmful to the tomato plant are also not very effective in controlling the disease.

Another point to consider in discussing control measures for tomato blight is the kind of planting. In a commercial field the object is to get as high a yield as possible as early as possible. In a home garden, high yields and earliness are not important. The object for the home garden should be to maintain the plants in a healthy condition for as long as possible so as to prolong the picking season and have fresh fruit for the home over a long period. It is therefore advisable that the tomatoes in the home garden should be sprayed.

Spray Recommendations for Tomatoes

I. *For the home garden:* Spray with 2-2-50 Bordeaux mixture (2 lbs. bluestone, 2 lbs. hydrated lime, 50 gallons of water). Begin spraying about the time the plants have begun to set fruit, and spray about every 10 days. Cover both surfaces of the leaves thoroughly.

II. *For the commercial planting:* Watch your plants. As long as the spots are limited to the lower leaves, do not spray. If the spots begin to spread to the upper, younger leaves early in the season (late May or early June), then begin to spray and spray about every 10 days. Use either 2-2-50 Bordeaux or some of the Bordeaux substitutes that are on the market, such as Spraycop, Cuprocide, Tri-basic copper sulphate, etc. These commercial copper compounds differ widely in the percentage of copper they contain so it is well to follow the directions of the manufacturer as to what amount to use.

A copper dust may be used instead of a spray. There are several such prepared dusts on the market (such as Copox, Tri-basic, Cuprocide, etc.) which can be easily obtained from any seed store or farmers' supply house. These should be used according to the recommendations of the manufacturer. The dust has some advantages over the spray. It is less harmful to the plant than the spray and it is easier to apply. The main disadvantage of the dust is that it does not stick as well as the spray and it may be washed away by rains.

Mosaic

(*Virus*)

Symptoms: There is considerable variation in the appearance of mosaic symptoms depending on growth conditions, strain of mosaic, stage of growth at which the plant became infected, etc. In general the leaves of mosaic-infected plants are mottled with light green or yellowish areas interspersed among the normal green color of the leaves. The leaflets are stunted and considerably distorted and malformed. Sometimes the leaflets become narrow, ribbon-like. When infection starts early the entire plant becomes much stunted and is practically worthless. If the plant becomes infected when full grown, the damage from mosaic is very small.

Control: Mosaic is a systemic disease. By this is meant that the causal agent of the disease is in the sap of the plant. Sprays and dusts, therefore, are ineffective against mosaic. Prevention is the only practical control measure against this disease. Mosaic is very infectious. It is spread by insects and by the handling of the plants by the workers, especially during the transplanting and pruning operations. The following preventive measures are recommended:

1. Prevent infection in the seed bed and cold frame by spraying periodically with nicotine (Black Leaf 40) to kill the plant lice. This is important, for plants which become infected when very young are worthless.

2. Since mosaic can be spread very easily from diseased to healthy plants by means of the pruning knife, reduce the pruning operation to a minimum. Remove the side shoots up to the first flower cluster then prune no more. Most of the suckers and side shoots can be jerked off by hand without using a pruning knife and without touching the rest of the plant.

3. Do not plant the fall crop of tomatoes near any surviving plants of the spring crop. By the end of the summer any surviving tomato plants from an early planting are almost invariably infected with mosaic which may easily spread to the new plants by insects. Also the fall crop should, as far as possible, be planted away from peppers and from garden flowers such as petunias and zinnias, for the mosaic virus can infect all these, as well as many other plants.

Root Knot

(Heterodera marioni)

Root knot is a disease familiar enough not to need description. It is caused by a soil-inhabiting microscopic worm (nematode) which invades the root tissues causing them to form the familiar galls or knots (Fig. 19). Nematodes occur universally in the soils of regions with mild winters such as those prevailing in the South. They attack a very large number of plants. Among the vegetable crops, tomatoes and cucumbers are very susceptible. Nematodes are especially troublesome in light sandy soils.

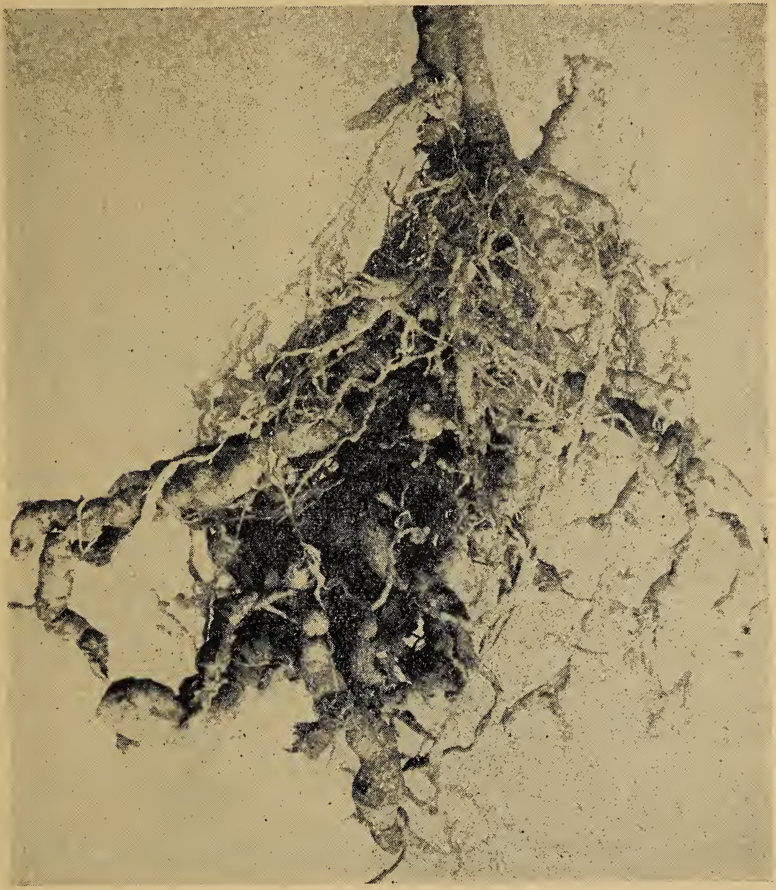

FIGURE 19.—Enlarged Roots of Tomato Caused by the Root-knot Nematodes.

No practical control is known for nematodes under normal field conditions. As far as possible tomatoes should not be planted on light sandy soil which is infested with nematodes. This is especially true in the case of the fall crop of tomatoes. The spring crop is planted while the temperature of the soil is still relatively cool and the nematodes are not very active; thus the plants escape heavy nematode infestation in the early stages of their growth. For this reason the damage to the spring crop of tomatoes from root knot is usually not so severe as on the fall crop. If a piece of ground becomes heavily infested with nematodes, partial relief may be obtained by keeping the land clean-cultivated during the warm season of the year, or by planting a root-knot resistant crop such as corn, sorghum, velvet bean, peanuts, or the Iron Clay variety of cowpea for two or three successive years. When such root-knot resistant crop is planted it is essential to cultivate between the rows to destroy the weeds because many of the weed plants are susceptible to the root-knot nematodes.

Southern Wilt (Southern Blight)

(*Sclerotium rolfsii*)

This disease causes the death of an occasional tomato plant in the field, but it is of minor importance. (See under pepper, page 30).

Blossom-End Rot

(*Non-parasitic*)

This is a disease of the fruit. For the most part it affects fruit that is about half grown, but it may be found on very young fruit (buttons) or on fruit that is nearly mature. It always affects the blossom-end part of the fruit. The rot starts as a water-soaked spot which enlarges, turns brown in color, and becomes dry, flat, or sunken. Later the killed tissue may be invaded by secondary organisms and become black and hard or soft and watery.

The cause of the blossom-end rot is not definitely known. It has been definitely established that the disease is not caused by any parasitic organism. Therefore, spraying or dusting will not control it. The disease is physiological in nature, that is, it is brought about by some disturbance of the normal growth of the plant. It has been found that the disease is worse where the nitrogen part of the fertilizer is supplied from manure or from other organic nitrogenous materials such as dried blood or cottonseed meal than where nitrate of soda has been used. Also, abrupt changes in weather conditions, especially drought following a wet spell, brings about an increase in blossom-end rot. No practical control measure is known for this disease. Some varieties are less subject to this disease than others. Of the varieties currently grown in Louisiana, Marglobe and Prichard are the least susceptible.

Other Rots of the Tomato Fruit

There are several other rots of the tomato fruit caused by different parasitic organisms, such as the Anthracnose rot (caused by the fungus *Colletotrichum phomoides*) and the Phoma rot (caused by *Phoma destructiva*). While these and other rots are usually initiated in the field, they are primarily diseases of storage and will not be discussed here.

TURNIP

The turnip, like many other members of the crucifer family of plants, is a cool weather plant. During the cool seasons of the year it grows well and is free from any serious diseases. In recent years, some attempts have been made to grow turnips in the summer (late July or early August), and these attempts almost always have resulted in failure. Diseases are the chief factor for this failure. Two diseases—web blight and white spot—are especialy destructive.

Web Blight

(*Rhizoctonia microsclerotia*)

For description, see page 8.

White Spot

(*Cercosporella albomaculans*)

Description: The white spot disease is caused by a fungus parasite. The disease is characterized by white or ashen-colored dead spots on the leaves. These spots vary in size from about one-eighth to one-fourth inch in diameter and are circular to angular in outline. When the spots are numerous the plant turns yellow, shrivels, and dries up ("scorches").

Control: White spot can probably be controlled by spraying with 4-4-50 Bordeaux mixture, but we have no information on this subject based on experiment. Even if it be assumed that this particular disease can be kept in check by spraying, it would still be impractical to try to grow turnips in the summer because of other diseases. No control is known, for example, for web blight (see page 8). The only practical way of avoiding diseases of turnip is to refrain from attempting to grow this cool-weather crop during the hot summer months.

Section II. Fruit Diseases

APPLE

Fire Blight

(*Erwinia amylovora*)

See pear, page 70. Apples are more resistant to fire blight than pears.

Rust

(*Gymnosporangium spp.*)

Description: The rust fungus passes part of its life on the apple and part on the cedar (Fig. 20). On the cedar it forms the well-known swellings or galls ("cedar apples"). On the apple it causes spots on leaves, fruit, and sometimes on young twigs. The spots on the leaves and fruit are orange-yellow in color and a blister or cushion forms in the center of each spot. Later, minute cup-like structures form on the blistered area of the spot.

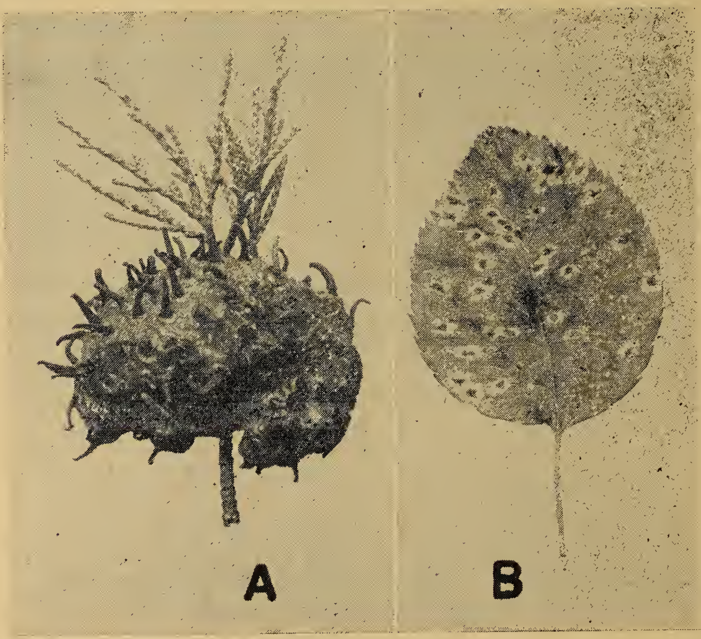

FIGURE 20.—APPLE RUST. A. "CEDAR APPLE," OR THE CEDAR STAGE OF THE RUST. B. RUST PUSTULES ON APPLE LEAF.

Control: Since the rust requires both the apple and the cedar to complete its life cycle, the most effective way to control it is to eliminate the cedar trees. In many of the commercial apple-growing regions, the general practice is to destroy all cedars for a distance of about one mile around the apple orchard. In Louisiana, where apples are not grown commercially, this method cannot be recommended, for the cedars are usually more valuable than the apples.

Spraying with Bordeaux or lime sulphur, or dusting with sulphur can control the rust, but this is not practical for the average grower, because about 7 applications of spray or dust are necessary and these have to be made at the critical period during which the rust is discharging its spores from the galls of the cedars. If spraying or dusting is not done at the right time, no control is obtained.

Fruit Rots

Several fungus diseases affect the apple fruit at various stages of its development, causing various spots and rots. The most important of these are:

1. *Blotch:* Dark-brown to black blotches with irregular margins on the fruit. Small, angular spots on the leaves, and cankers on the twigs.

2. *Black rot:* (See pear, page 74).

3. *Bitter Rot:* Sunken, more or less watery, pinkish to brown rot spots on the fruit.

Spray Schedule for Apples[9]

TIME	Spray Mixture			For
		Large Amts.	*Small Amts.*	
Dormant	Oil emulsion Water	2 gal. 50 gal.	1 pint 3 gal.	San Jose Scale
Pink clusters, buds separated	Liquid lime sulfur Water	1 gal. 50 gal.	1/2 pint 3 gal.	Scab
Calyx (3/4 petals fallen)	Liquid lime sulfur Hydrated lime Lead arsenate Water	1 gal. 3 lbs. 1 1/2 lbs. 50 gal.	1/2 pint 3 oz. 1 1/2 oz. 3 gal.	Codling moth worms Scab
Two weeks after petals fall	Same as calyx spray			Codling moth worms
When apples are well grown but not ripening	Hydrated lime Copper sulfate Lead arsenate Water	3 lbs. 3 lbs. 1 1/2 lbs. 50 gal.	3 oz. 3 oz. 1 1/2 oz. 3 gal.	Codling moth Bitter rot Blotch
	Four pounds of dry lime sulfur may be substituted for one gallon of liquid lime sulfur			

Control: In commercial apple orchards the various fruit rots are effectively controlled by following rigid spraying schedules. In small home orchards where facilities for adequate spraying are usually lacking, control of these diseases is difficult. Sanitary measures are helpful in keeping them in check. All dead wood and all rotted and mummied fruit should be removed and burned. The spray schedule, if followed, will insure reasonably clean fruit, although it is not calculated to give complete control.

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[9] This spray schedule was prepared by C. O. Eddy and A. G. Plakidas of The Louisiana Agricultural Experiment Station, with the advice of Horticulturists, Extension Specialists, Agricultural leaders and growers.

BLACKBERRY AND DEWBERRY

Leaf Spots

There are several fungi which cause spotting of the foliage of blackberries and dewberries (Fig. 21). Two of these, *Cercospora rubi* and *Septoria rubi,* are the most common ones in Louisiana. Sometimes these leaf-spotting diseases cause considerable defoliation of the plants by late summer, and this naturally affects the vitality of the plants and their fruitfulness the following spring.

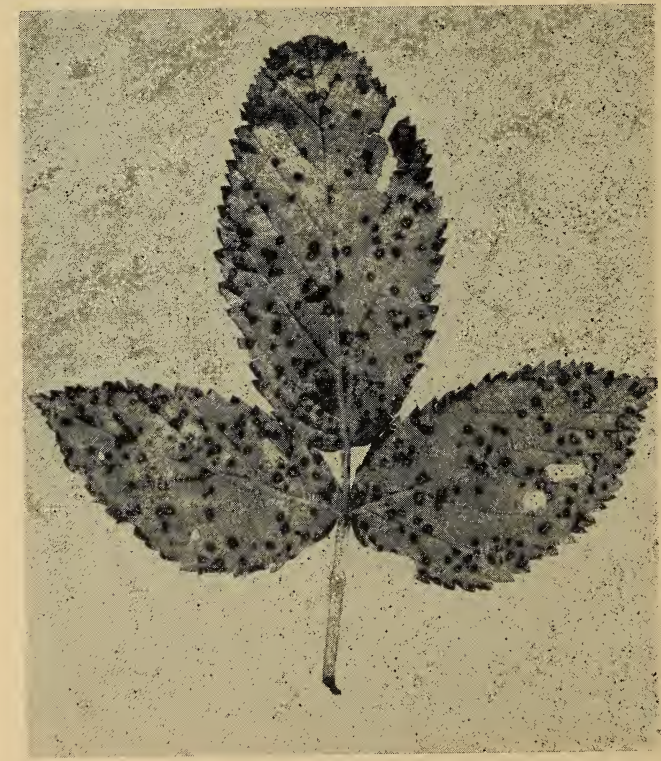

FIGURE 21.—*Septoria* LEAF SPOT OF BLACKBERRY.

Control: No tests have been made in Louisiana aimed directly toward the control of blackberry and dewberry leaf spots. However, in the course of some spraying experiments for the control of the rosette disease

(See below), it was noted the 4-4-50 Bordeaux mixture controlled the leaf spots very well. The sprayed plants reached late summer with green foliage while the non-sprayed ones were badly spotted and defoliated. Whether or not it would be economically profitable to spray blackberries and dewberries for the control of the leaf spots is a matter for the grower to determine, but it would seem that one application of 4-4-50 Bordeaux before blooming and about two more applications later on, during June and July should keep the leaf spotting diseases in check.

Cane Blight

In the spring, some of the fruit canes appear weak and have dead patches or cankers on the bark. As the weather warms, some of these die back. There are several fungi that can cause cane blight. *Leptosphaeria coniothyrium* is the most common one in Louisiana. Winter injury is a contributing cause. This is especially true in South Louisiana where the plants do not become dormant in the fall but continue active growth until there is a killing frost.

Control: Cut out and burn all the old canes as soon as the fruit is harvested. This will not completely control cane blight, but will help by eliminating the main source of infection.

Rosette

(*Cercosporella rubi*)

Description: The rosette disease is very striking and very easy to recognize (Fig. 22). In the spring diseased canes give rise to multiple shoots which produce a bunchy type of growth (witches' brooms). The diseased flower buds are loose, puffy, and elongated, instead of being round and compact like the healthy ones. Diseased flowers do not set fruit and sometimes the flower parts become leaf-like in growth. After the flowers begin to wither they become covered on the inside with a white powder which is made up of the spores of the fungus.

Control: Control measures recommended for rosette will be better appreciated if a brief description is given of the cycle of development of the disease. The fungus (*Cercosporella rubi*) which causes the rosette disease produces spores only on the withered blossoms in the spring. When the spores fall on the new canes they germinate and grow inside the buds. Infected canes do not show any disease symptoms until the next spring. The period during which the new canes are susceptible to infection is limited. No infection takes place after about the first of June.

Summary of Control Measures

1. Do not allow any wild blackberries or dewberries to grow close to your berry plantings, as the rosette disease will spread from the wild to the cultivated vines.

2. Inspect the plantings in the spring and remove any rosette growth that may be present. This will eliminate the source of infection from the

immediate vicinity of the plants. This cutting off of the rosette growth should be done early in the spring (preferably in February) before the opening of the blossoms, that is, before the spores of the fungus have been formed.

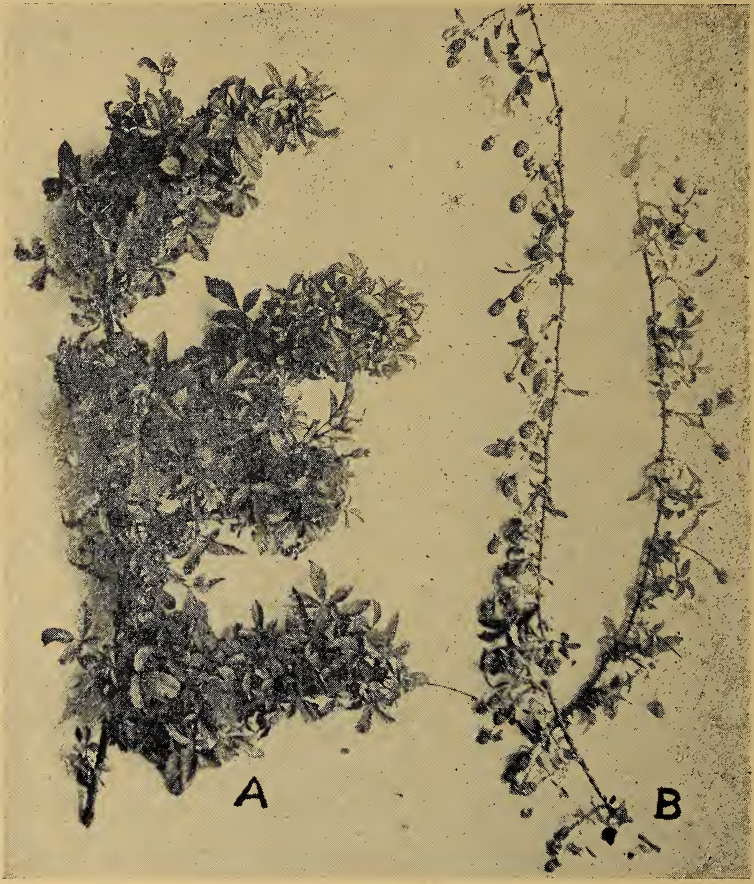

FIGURE 22.—Rosette on Dewberry. A. Diseased Cane. B. Healthy Canes. Note That the Rosette Cane Has Set No Fruit.

3. Prune all the new canes to the ground about the first week in May. This will eliminate all the canes that may become infected up to this period.

4. Spray the new canes that develop from the time of pruning until the first week in June with 4-4-50 Bordeaux. The spraying should be done about every 10 days. Two to three sprayings should be sufficient.

5. Do not plant dewberry plants that come from tip layering of rosette canes.

Rust

Description: Two kinds of rust occur on blackberries and dewberries, the orange rust (*Kunkelia nitens*) and the yellow rust (*Kuhneola uredinis*).

The orange rust forms orange-colored masses of spores on the undersides of the leaves. It occurs just as soon as growth starts in the spring and usually covers all the new growth of the plant.

The yellow rust appears later and occurs as scattered yellow pustules mostly on stems, but also on leaves, throughout the summer and fall.

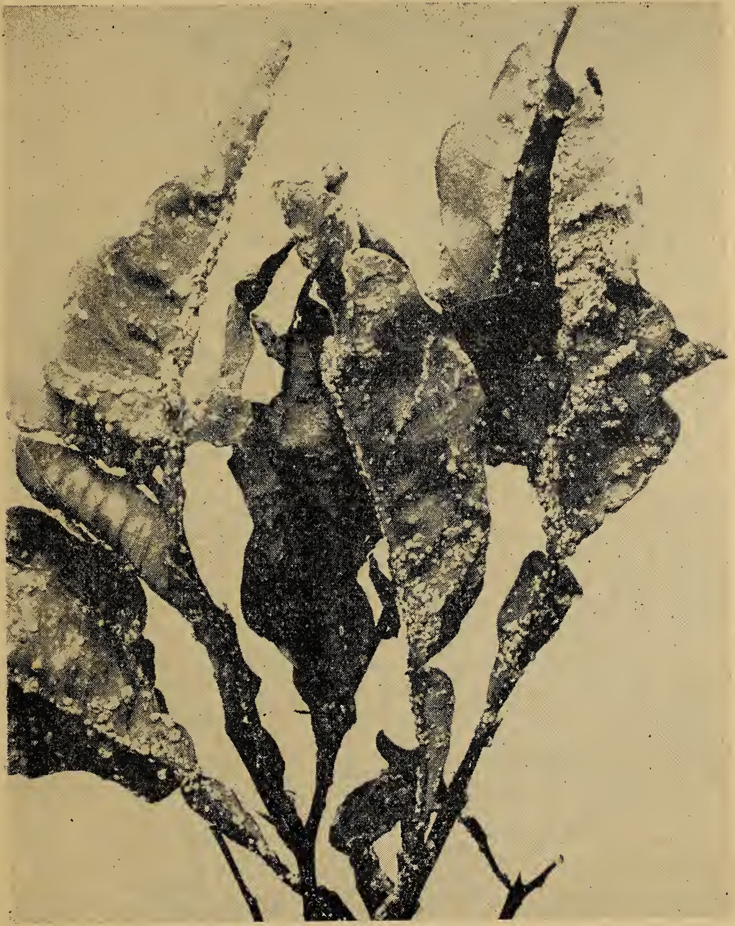

FIGURE 23.—Scab on Sour Orange.

Control: The yellow rust is not important and there is no need to attempt to control it. The orange rust, on the other hand, is very destructive. It is systemic within the roots and crown of the plant and therefore it cannot be controlled by sprays or dusts. The affected plants should be dug up, roots and all, and burned.

Crown Gall

See peach, page 68.

CITRUS

Citrus trees and their fruits are subject to a very large number of diseases. No attempt is made to describe or discuss all the citrus diseases in this popular bulletin. Only the most common ones are considered.

Scab

(*Sphaceloma fawcettii*)

Scab is primarily a disease of satsuma orange, tangerine, grapefruit, lemon, sour orange, and *Citrus trifoliata.* It does not affect the sweet orange. Scab affects fruit, leaves, and young shoots, causing irregular, raised, corky, scabby, wart-like outgrowths (Fig. 23). Severely scabbed leaves and fruits become misshapen and distorted. The rind of scabbed fruit is thick and puffy.

Control: Scab control is based on the fact that infection occurs only on young, immature growth, provided there is sufficient moisture in the atmosphere and that the temperature is neither too high nor too low (about 59° to 74° F. is the optimum). This combination of conditions usually prevails during the flush period of growth in the spring and it is during this period that the trees should be sprayed. (See Spray Schedule, page 59).

Melanose

(*Diaporthe citri*)

Description: Like scab, melanose is caused by a fungus (*Diaporthe citri*), and it also affects leaves, shoots, and fruit. It forms very numerous, dark brown dots or spots on the leaves, young shoots, and fruit (Fig. 24). These spots are at first sunken, but later become raised so that the russeted area has a rough, sand-paper feel. The spots may be irregularly scattered on the surface of the fruit, or they may run in streaks ("tear-stains"). Like scab, melanose infection occurs only on young, tender growth. The fruit becomes progressively resistant with age. However, the same fungus that causes melanose can infect the ripe fruit after harvest. It is one of the two most common causes of the very destructive fruit decay known as stem-end rot. Control of melanose, therefore, helps to reduce the losses from stem-end rot.

Control: Two methods are used for the control of melanose, sanitation and spraying.

1. *Sanitation:* The melanose fungus does not produce spores on the living parts of the plant (leaves, shoots, and fruit), but only on dead

twigs and branches. Therefore, pruning and burning the dead wood is a great help in controlling this disease because the practice eliminates much of the source of infection.

2. *Spraying:* See Spray Schedule, page 59.

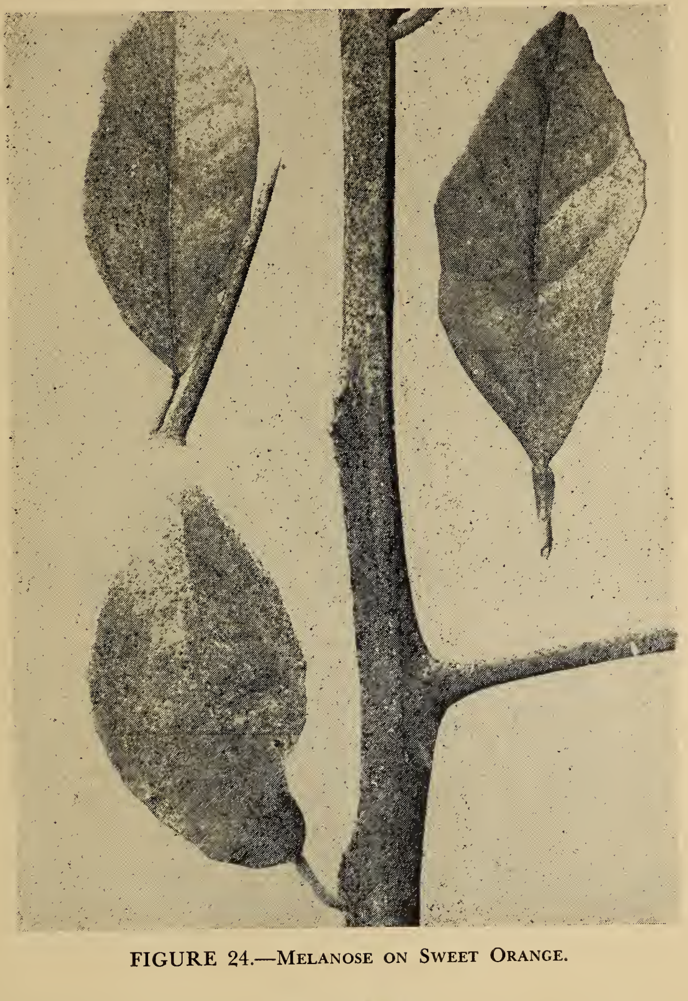

FIGURE 24.—MELANOSE ON SWEET ORANGE.

Sooty Mold

Description: The sooty mold fungus (*Capnodium citri*) is not a parasitic organism. It does not penetrate the tissue of the plant but grows superficially on the honeydew excretions of white flies, aphids, and scale insects. Sooty mold causes a certain degree of injury when its growth is very thick by preventing the sunlight from reaching the leaf, and by making the fruit black and unattractive. Fruit that is covered with sooty mold is smaller in size and does not color well.

Control: Sooty mold is controlled indirectly by controlling insects (white flies and scale) which excrete the honeydew on which the sooty mold fungus grows. When these insects are killed the sooty mold disappears. See Spray Schedule, page 59.

Lichens

Description: Growth of different kinds of lichens (commonly called "moss," locally) often occurs on trunks, branches, and sometimes on leaves of citrus trees. Lichen growth is less abundant on healthy, vigorous trees than on neglected, weakened trees which are growing poorly. For this reason the presence of lichens is often blamed for the unthrifty condition of the trees, when in fact the reverse is true; the lichen growth is abundant because the tree is unthrifty from some other cause. Lichens are generally considered harmless. They are not parasitic, do not invade the tissue of the bark, and cause no damage to the tree. An exception to this general statement may be made in the case of one kind of lichen (*Melanotheca sp.*). This species, which makes a grayish, compact, pimply type of growth on trunks and branches, probably causes a slight damage. The bark underneath the lichen growth, although not killed, appears damaged. It is somewhat sunken and brownish in color.

Control: Lichens are easily controlled by spraying with Bordeaux. The regular spray schedule (page 59) for the control of other diseases is usually sufficient to control the lichens also. If desired, stronger concentrations of Bordeaux mixture, 4-4-50 or 5-5-50, may be applied to the trunk and branches for the control of lichens.

Fruit Rots

Because the bulk of the fruit is sold locally, mostly on the New Orleans market, almost as soon as it is picked, the Louisiana citrus grower is not confronted with the serious problems of storage and transit rots that the citrus shipping states have to face. This does not mean that fruit rots are not important. Even though the grower may dispose of his fruit before it rots, some one along the line, whether it be the commission merchant, the grocery man, or the housewife, will suffer a loss if the fruit rots before it is consumed, and this loss will ultimately be passed back to the grower in the form of lower prices. Therefore, every effort should be made to prevent fruit decay.

In considering means of keeping losses from fruit rots to a minimum, the following facts should be kept in mind: (1) fruit rots are caused by parasitic fungi (molds) which invade the tissue of the fruit and cause it to rot; (2) these molds infect the fruit for the most part through cuts, wounds, bruises, thorn pricks; (3) the spores of these molds are produced in vast numbers on dead twigs and branches and on rotten fruit; (4) moisture is necessary for the germination of the spores.

With these facts in mind, the precautions to be taken for preventing fruit rots are obvious. Fruit should not be picked when wet, or, if picked when wet, provisions should be made for drying it as soon as possible after it is picked. Dead wood of all kinds should be removed from the trees. This practice will help to keep down the losses from stem-end rot. Also, since one of the fungi which causes stem-rot is the same fungus which causes melanose, spraying for melanose helps to prevent stem-end

Spray Schedule for Citrus

This program was arranged and was revised on January 30, 1942, by a committee of growers and technical men at a meeting in Plaquemines Parish. It is based on information supplied by the Louisiana Agricultural Experiment Station, Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture, Louisiana State Department of Agriculture, the Louisiana Agricultural Extension Department, the Citrus Experiment Station of the University of Florida, and Plaquemines Parish County Agent.

TIME	Sprays or Dusts	For Control of
1*. Pregrowth sprays. Stop before blooming	A. For all fruits except satsumas: Liquid lime sulphur $1\frac{1}{2}$ gals. per 100 gals. water plus 6 lbs. of wettable sulphur. Or dust with sulphur if sprayer is not available.	Rust Mite
	B. For Satsumas: Bordeaux mixture 3-3-100 or its fungicidal equivalent in other recommended forms of copper. Six pounds of wettable sulphur should be added.	Scab Rust Mite
2*. One to four weeks after blooms. (Stop approximately four weeks after blooms)	Bordeaux mixture 3-3-100 with 6 lbs. wettable sulphur	Melanose Rust Mites Scale Crawlers Lichen (Moss)
3*. June and early July	Oil emulsion $1\frac{1}{4}$ to $1\frac{2}{3}\%$ actual oil. Spray leaves, twigs, and all wood thoroughly. (See footnote on oil).	Purple Scale Red Scale Other Scale White Fly Red Spider
4. September and October. For all varieties except Satsumas use A or B or both at proper interval. See note on oil.	A. Oil emulsion $1\frac{1}{4}$ to $1\frac{1}{2}\%$ actual oil. (See note on oil)	Red Spider Purple Scale White Fly Red Scale
	B. Sulphur spray: 1 gal. liquid lime sulphur with 6 lbs. wettable sulphur or sulphur dust.	Rust Mite

*The sprays marked with an asterisk are most important ones for the home orchard.

Caution: Oil and sulphur are not compatible and will cause severe injury if mixed. Never mix oi and sulphur in the same spray, and always allow at least three weeks interval between oil and sulphur applications.

rot. Every effort should be made to prevent injury to the fruit during the operations of picking and packing. The pickers and packers should be provided with gloves to prevent nail scratches. The boxes should be kept clean and in good condition with no splinters or protruding nails.

No decaying fruit should be allowed to stay in or in the vicinity of the packing house. If the fruit is washed, it should be dried as rapidly as possible. Borax, at the rate of 5 to 8 per cent, either in the wash water or in a separate dipping tank, helps to keep down fruit rots.

Nutritional Troubles

It is known that some nutritional troubles, brought about by deficiencies in one or more of the so-called "minor" elements (zinc, manganese, copper, etc.), do occur in some of the groves in Plaquemines Parish. These deficiency troubles are characterized by various chlorotic patterns on the leaves, by die-back of the twigs, by growth abnormalities, etc. These troubles have not been studied sufficiently in this State to be well understood or to make recommendations for their correction.

FIG[10]

Leaf Blight

(Caused by several species of Corticium)

The Corticium leaf blight is the most serious disease affecting fig trees in Louisiana. There are three different fungi (Corticiums) that cause blighting of fig leaves. They are very much alike in general symptoms and the control measures are the same for all three types; for this reason they are grouped together.

Leaf blight usually appears late in May or early in June. The worst damage usually occurs during the prolonged rainy spells. Leaves and fruit are attacked by the leaf blighting fungi. The injury is confined to the loss of leaves and fruit.

Description: The blight first shows up as irregular-shaped brown spots on the leaves. Infection usually starts at the base of the leaf and spreads in a fan-like manner, forming a large semi-circular brown discolored dead spot. Infected leaf tissues may shrivel up and fall out, producing a shot-hole effect, or the edges of the leaves may slough off, leaving them quite ragged in appearance. Some leaves may have the white or light brown colored, powdery-looking fruiting layer of the *Corticium* on the lower surfaces. When conditions are favorable, large numbers of leaves may be completely killed within a few days, leaving some limbs completely bare. Most of the damage occurs before the fruit ripens. On the limbs where the leaves are killed the fruit usually shrivels up or does not ripen properly.

The three fungi that cause leaf blight of fig are: (1) *Corticium stevensii* (the threat blight fungus) which produces small, brown, shiny hyphal threads on the small twigs, petioles, and leaves, and irregular-shaped, brown sclerotia on the twigs (Fig. 25). Leaves killed by this fungus usually hang on to the twigs by the small hyphal threads in a characteristic way. (2) *Corticium microsclerotia* is characterized by the production of large numbers of small, brown sclerotia about half the size of mustard seed on the twigs, fruit, and leaves. (3) An undetermined species of *Corticium* which differs from the other two forms in the absence of any definite sclerotia or hyphal threads.

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[10] The section on Fig diseases has been prepared by Dr. E. C. Tims.

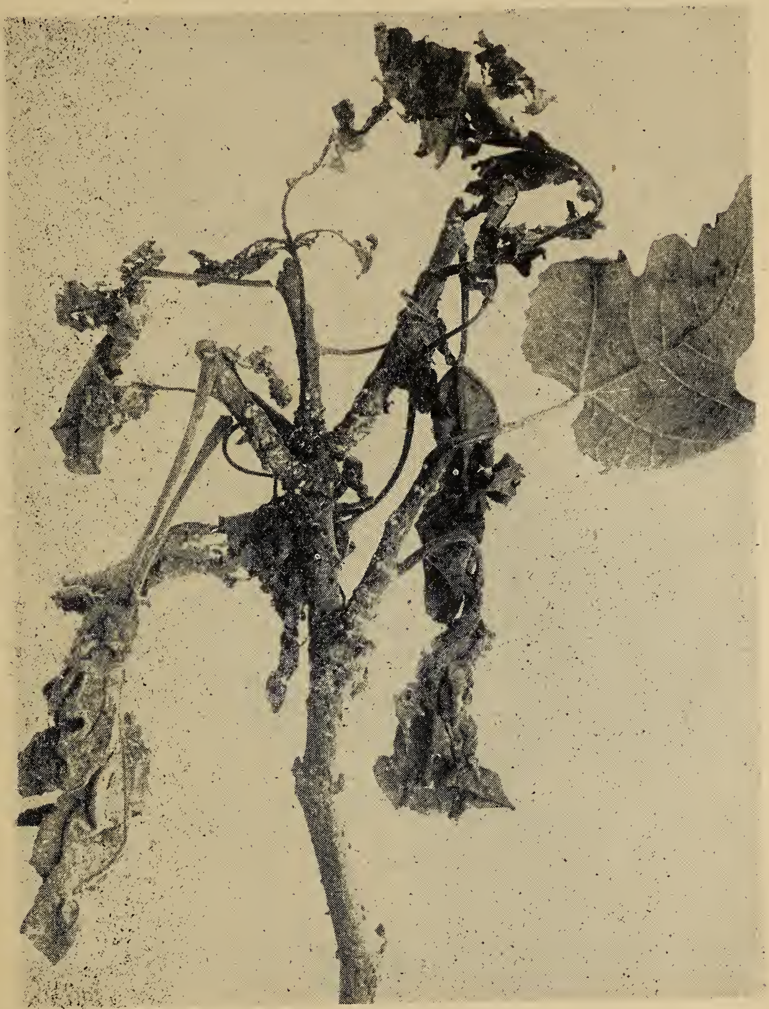

FIGURE 25.—THREAD BLIGHT ON FIG.

Control: Two types of sprays have been used successfully for the control of fig leaf blight. A dormant spray mixture applied during the winter when the trees are free of leaves has been effective in the control of thread blight. The dormant spray mixture consists of copper sulphate 1½%, lime 1%, zinc arsenite 1%, monocalcium arsenite ¼%, and fish oil 1% (the percentages being by weight except the fish oil, which is measured by volume). One application of this spray mixture in December or January is usually sufficient for the control of thread blight. It should never be applied when the leaves are on the trees.

The arsenite (dormant) spray has been effective in the control of leaf blight caused by *Corticium microsclerotia,* or *Corticium sp.,* except in certain seasons when there was excessive rainfall in June and early July. Under such conditions one application of Bordeaux mixture (4-4-50) made between May 10 and June 1 has controlled the leaf blight caused by the two above mentioned fungi.

If fig trees are slightly diseased (that is, if only a few dead leaves appear during June or early July) one application of Bordeaux mixture is sufficient to control the disease. If trees are known to be severely diseased (large areas of dead leaves before the fruit ripens) a combination of the dormant (arsenite) spray and Bordeaux mixture may be necessary.

Rust

(*Physopella fici*)

Description: Rust is caused by *Physopella fici,* a fungus which is widespread over the State. It first appears as small yellowish to reddish pustules on the lower surface of the leaves, which enlarge and become more numerous until almost the entire surface may be involved. Many fig trees are completely defoliated by rust before the end of the summer, although the disease seldom develops early enough to damage the leaves seriously before the fruit ripens. The only serious aspect of the disease is premature defoliation of the trees.

Control: Measures used in the control of fig leaf blights have reduced the amount of rust to some extent.

Cercospora Leaf Spot

Description: This leaf spot, caused by *Cercospora fici,* is widespread in the State but causes only slight damage. The spots are brown in color, roughly circular in shape, and vary in size up to about ½ inch in diameter. The spots may coalesce to form larger areas of dead tissue.

Control: Control measures are usually unnecessary. Bordeaux mixture applied in May or early June will greatly reduce Cercospora leaf spot.

Limb Blight

Description: This disease is caused by the fungus *Corticium salmonicolor.* It is characterized by the sudden dying of twigs or branches up to 2 inches or more in diameter, with the production of bright pink color on the bark of the diseased twig. The leaves on the dead twigs usually turn a dark brown color and hang on for weeks after they are killed. This type of limb blight often recurs in the same trees year after year, sometimes causing considerable damage.

Control: No effective control measures are known. Pruning out diseased branches should be of some help.

Fig Canker

The fig canker is caused by the fungus *Tubercularia fici.* It is widely scattered over the State and causes some damage to many trees. The cankers appear as irregular-shaped swellings with sunken areas in the center. They partially girdle the twigs and small branches, killing some and weakening others so they break easily.

Control: The cankers should be cut out.

Stilbum Disease

Description: This disease is caused by a fungus called *Stilbum cinnabarinum.* It causes a dying of twigs and even limbs on fig trees. Diseased areas are characterized by the presence of small pink fungus heads borne on short stalks growing on the bark. Infection takes place through wounds of various types, and may occur through the leaf scars on small twigs.

Control: Control measures are rarely necessary for the Stilbum disease, but where it occurs, the infected branches can be pruned out.

GRAPE

In discussing diseases of grapes, the varieties of grapes grown should be considered. Grapes are not grown commercialy to any extent in Louisiana. In home gardens, two types of grapes are grown, the muscadines and the American bunch grapes.

From the practical standpoint, the muscadines are relatively free from diseases. The black rot fungus causes considerable spotting of the foliage, especially of the Scuppernong variety, but it does not affect the fruit to any appreciable extent. Two other fungi, *Cercospora sp.* and *Isariopsis clavispora,* also cause spotting of the leaves late in the season but they are not serious. In general, it may be safely stated that none of the diseases affecting the muscadine grapes causes sufficient damage to justify control measures.

The bunch grapes, on the other hand, are subject to many serious diseases, and unless one is prepared to practice control measures, one should not attempt to grow bunch grapes in Louisiana. The following are among the most important diseases of bunch grapes.

Black Rot

(*Guignardia bidwellii*)

Description: The black rot fungus affects the leaves, berries, fruit stems, and sometimes the young canes. It causes numerous definite brown dead spots on the leaves. The berries are affected in all stages of their development but most severely when they are one-half to two-thirds grown. The rot on the berries starts as a purplish or brown spot which spreads fast, and soon rots the entire berry which turns black in color and later dries and shrivels. The dried, mummified berries remain attached to the stem.

Control: See Spray Schedule.

Anthracnose

(*Elsinoe ampelina*)

Description: Like the black rot, the anthracnose fungus attacks the leaves, shoots, fruit stems, and berries. On the leaves the spots are small, angular, with pale-brown centers and reddish-brown margins. On the berries, the spots are circular, sunken, and each is surrounded by a purplish to dark-colored border. The appearance of the rotted spots on the berries has given this disease the common name of "bird's eye rot." Spots, somewhat similar to those on the berries, develop also on the young shoots. Sometimes the spots are so numerous that the young shoots are girdled and killed.

Control: See Spray Schedule.

Crown Gall

(See Peach, page 68.)

Root Rot

(Oak root fungus. See Pear, page 73.)

Spray Schedule for Grapes

APPLICATION	TIME	Spray Mixture	For
1	Dormant season	Concentrated lime-sulfur 1 gallon Water 8 gallons	Anthracnose, scale, and black rot spores
2	New growth about 1″ long	4-4-50 Bordeaux	Anthracnose and black rot
3	Pre-blossom when first blossoms are opening	Same as preceding spray. Add to each 50 gallons of spray 1 lb. calcium arsenate, 1/2 lb. soap chips, or 1 pint of liquid soap as a spreader to make the spray adhere.	Anthracnose, black rot, leaf-chewing insects.
4	Post-blossom when bloom is nearly complete	Same as above	Anthracnose, black rot, leaf-chewing insects
5	2 weeks after 4 application	4-4-50 Bordeaux	Anthracnose, black rot
6	When fruit is about half-grown	4-4-50 Bordeaux	Black rot and other fungus diseases

PEACH AND PLUM

Peach and plum are grouped together here for the reason that these two crops have many diseases and insect pests in common, and for the most part the same control measures are applicable to both.

Scab

Description: Scab is caused by a fungus, *Cladosporium carpophilum.* It is characterized by greenish to black spots on the peach fruit (Fig. 26, A). The spots are usually localized on one side of the fruit near the stem end. When the infection is servere, the scabby part of the fruit cracks. The disease also forms irregular blotches on leaves and small cankers on tender twigs.

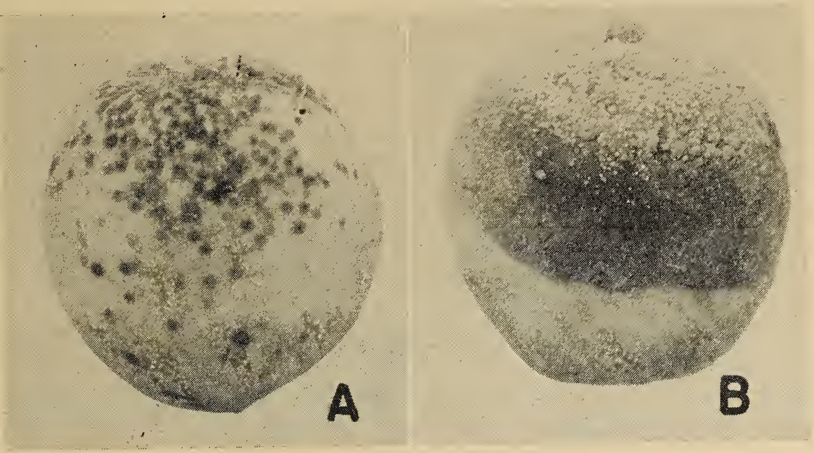

FIGURE 26.—A. Peach Scab. B. Brown Rot on Peach.

Control: See spray schedule, page 69.

Bacterial Leaf Spot and Cankers

This bacterial disease (caused by *Phytomonas pruni*) affects both peach and plum. It causes "shot-hole" spots on the leaves and roughening and spotting of fruit. Affected areas or spots on the fruit are usually sunken. It also causes small, thick-edged cankers on twigs and large cankers on branches and trunks.

Control: (1) As a preventive measure, nursery stock should be carefully inspected and any trees showing swollen cankers on the twigs should be discarded. (2) The more vigorous the growth of the tree, the more resistant it is to this disease. Therefore, good growing conditions by fertilization and cultivation should be maintained. Nitrogenous fertlizers are especially helpful. The application of nitrate of soda during the winter is recommended. (3) Spraying with zinc sulphate and lime (4 lbs. of zinc sulphate, 3 lbs. of hydrated lime, 50 gallons of water) gives a certain degree of control.

Leaf Curl

Description: This disease, which is one of the most serious diseases of the peach in most parts of the world, occurs only very rarely in Louisiana and it is of decidedly minor importance. It is due to a fungus (*Taphrina deformans*) which causes the young leaves to become thickened, twisted, curled and distorted (Fig. 27). The thickened portions of the leaf are pinkish with a whitish surface. Affected leaves fall off, resulting in defoliation of the tree. The fruit and tender twigs may also be affected.

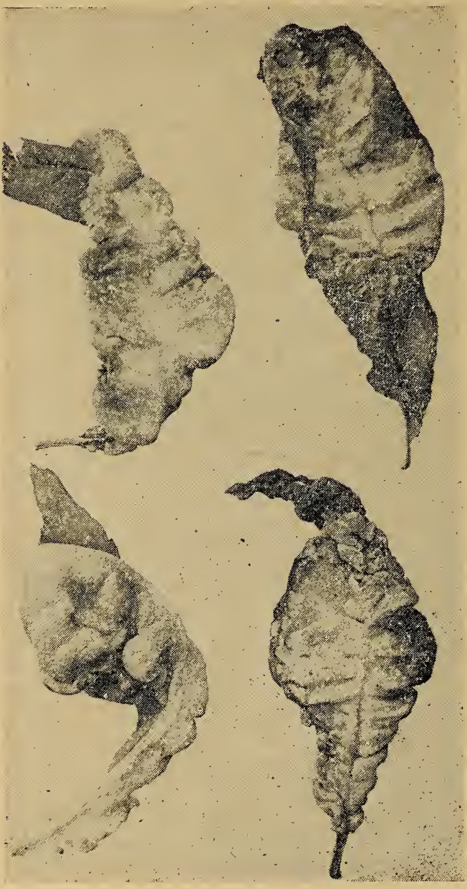

FIGURE 27.—PEACH LEAVES AFFECTED WITH LEAF CURL.

Control: Since leaf curl occurs only rarely in Louisiana, and when it does occur the infection is usually not severe enough to cause much damage, control measures are probably not justified. However, this disease can be controlled very easily by one application of lime sulphur (1 gallon in 8 gallons of water) during the dormant season (December-January). In the spray schedule (page 69) no provision is made for the control of leaf curl. If it becomes necessary to control leaf curl, substitute lime sulphur in place of the oil emulsion which is recommended in the spray schedule for the dormant spray. Lime sulphur will control the leaf curl and it will also control the scale, although not so well as the oil emulsion.

A Bordeaux-oil emulsion spray mixture may be used instead of the lime sulphur for the dormant application. To make this mixture, add 5 gallons of oil emulsion to 75 gallons of a 3-5-50 Bordeaux.

Plum Pockets

Description: Two other species of the same genus of fungus which causes leaf curl on peach cause the well-known plum "pockets" or "bladders" on plum. One of these (*Taphrina pruni*) affects the young plum fruits causing them to enlarge and become spongy and hollow, bladder-like. The other species (*Taphrina mirabilis*) affects primarily the young leaf buds and the tips of the young twigs, distorting them and producing fleshy, spongy, hollow overgrowths. This is especially bad on the Chickasaw plum and its relatives.

Control: No satisfactory control is known for this disease.

Black Knot

Description: This disease is striking in appearance and easily recognized by the large, black, warty swellings or knots on branches of the plum tree. It is caused by a fungus (*Plowrightia morbosa*) which invades the woody parts of the tree.

Control: Prune out during the fall and winter all diseased branches and burn. The cut should be made several inches below the knot so as to remove part of the fungus which is growing inside the tissue beyond the limits of the knot. Spraying (see spray schedule, page 69) also helps to prevent new infections from getting started.

Brown Rot

(*Sclerotinia fructicola*)

Description: Brown rot is by far the most important disease of peaches and plums in Louisiana. It affects the blossoms in the spring causing blossom blight. It causes cankers on twigs and branches, and causes rot of the fruit on the tree and in storage. The phase on the fruit is the most serious and most destructive. It may affect the fruit in various stages of its development but it is most prevalent as the fruit approaches maturity. On the fruit the rot starts as small, circular, soft, brown spots which enlarge very rapidly so that in a very short time the entire fruit is rotted. The spots usually start at points where the fruit skin has been broken in some way, such as by worms, rubbing, hail, bruising, etc. The surface of the rotted part of the fruit becomes covered with a brown to gray mass of fungus spores (Fig. 26, B). After the fruit has rotted, it dries up, shrinks, and forms a dry, hard, shriveled "mummy."

Control: The brown rot fungus is carried over from one season to the next (1) in cankers on twigs and branches, (2) on fruit "mummies" which may remain hanging on the trees, and (3) in fruit "mummies" which fall to the ground. With these facts in mind, it is easy to understand the control measures recommended for this disease.

1. *Sanitation:* Sanitary measures are very important because they eliminate much of the primary source of infection. All dead wood should be pruned out during the winter. All fruit that falls to the ground should be collected and either buried deep, burned, or fed to hogs. Hogs make a very clean job of picking up fallen fruit, and where the trees are con-

veniently located so that hogs can be turned loose under them, this is the most efficient and cheapest method of cleaning up.

2. *Spraying and dusting:* See spray schedule, page 69.

Rust

(*Tranzschelia pruni-spinosae*)

Description: This disease forms reddish pustules on the underside of the leaves and on the fruit. The upper side of rusted leaves show yellowish spots and affected foliage sheds prematurely. Rust is of minor importance in Louisiana. It is more common on plum than on peach.

Control: The spray schedule (page 69) recommended for the other diseases will control the rust until harvest time. Occasionally rust infection may become severe enough on the leaves after the fruit is harvested to cause defoliation. In that case, it may be necessary to dust with sulphur, or to spray with wettable sulphur once or twice.

Root Knot

(*Heterodera marioni*)

The peach is very susceptible to the root knot nematode and it is injured severely if planted on nematode-infested soil, especially if the soil is sandy.

Control: Do not plant on soils known to be infested with nematodes. Some nematode-resistant rootstocks are now available. These are seedlings of some Chinese and Indian peaches. The Shalil and Yunnan appear to be the most promising ones. These have proved very resistant to nematodes and are, apparently, well suited to Louisiana conditions.

Crown Gall

(*Phytomonas tumefaciens*)

Crown gall is another disease caused by bacteria (see page 4). It is characterized by the formation of large, spherical or irregular, rough galls usually on the crown and larger roots of the tree, although not infrequently the galls may form on the aerial parts, on the trunk, and on the branches. Crown gall affects a very large number of different plants, both woody and herbaceous. The rose and blackberry are among those most severely injured. The peach, although very susceptible, does not appear to be seriously injured by crown gall.

Control: Trees are injured by crown gall more if they become infected when young (in the nursery or soon after planting). Therefore, all nursery stock should be carefully examined before planting and any trees showing galls should be destroyed. Since crown gall bacteria can survive in the soil for many years, young trees should not be planted in soil from which old, diseased trees have been removed.

Root Rot

(See Pear, page 73).

Phony Peach

(*Virus*)

The peach is subject to several destructive diseases caused by viruses (see page 5). Fortunately, some of the most destructive ones like "yellows," "little peach," and "X-disease" do not as yet occur in Louisiana. However, one virus disease of the peach, "phony peach," occurs in the State, although it is not very common. The symptoms of this disease are such that it is very difficult for the inexperienced man to diagnose them with certainty, and for this reason no attempt is made in this popular publication to describe them. A cooperative eradication campaign between the Federal and State Departments of Agriculture is at present in progress. Any grower who suspects that any of his trees are

Spray Schedule for Peaches and Plums

This program was assembled by entomologists and horticulturists with growers from the North Louisiana peach belt, using the best information available.

TIME	Spray Mixture		For
*Dormant season before buds swell.........	Oil emulsion containing 2% oil for light to moderate infestation, 3% for heavy infestation. See notes about oil.		Scale
Petal fall spray when 3/4 petals have fallen.	Lead arsenate Hydrated lime Zinc sulfate Water	1 lb. 4 lbs. 2 lbs. 50 gals.	Curculio (If and where needed)
*Shuck Fall Spray. 75% Shucks off..........	Lead arsenate Hydrated lime Zinc sulfate Water See directions for mixing	1½ lbs. 4 lbs. 2 lbs 50 gals.	Curculio
*10 days after shucks fall....	Lead arsenate Hydrated lime Zinc sulfate Wettable sulfur Water	1½ lbs. 4 lbs. 2 lbs. 3 lbs. 50 gals.	Curculio, Scab
Two weeks later............	Lead arsenate Hydrated lime Zinc sulfate Wettable sulfur Water	1½ lbs. 4 lbs. 2 lbs. 3 lbs. 50 gals.	Curculio, scab (omit lead arsenate if jarring shows no curculio)
*Three weeks before harvest.	Wettable sulfur Water	3 lbs. 50 gals.	Brown Rot
*Just before harvest........	Wettable sulfur Water	3 lbs. 50 gals.	Brown Rot

affected with phony peach can obtain an expert opinion from the State Department of Agriculture in Baton Rouge. Diseased trees should, of course, be destroyed to prevent the spread of this disease to healthy trees.

Explanatory Notes for the Spray Schedule

1. The sprays which are marked with an * are the most important ones for the growers (home orchardists) who must use a limited spray schedule.

2. *Dusting instead of spraying:* For the small home orchard, where a spray machine is not available and where a duster (usually a small cotton duster) is available, it may be advisable to dust instead of spray for the control of curculio, scab and brown rot. Dusts are not as effective as sprays because they do not adhere to the foliage well and are washed off by rains. For this reason it is better to spray whenever possible. If facilities for spraying are not available, dusting is the second best thing to do. Use the following dusts: (1) When about $\frac{3}{4}$ of the petals have fallen; 5 parts of arsenate of lead and 95 parts hydrated lime. (2) About 10 days later; same as in (1). (3) Two weeks after the second application; 80 parts of dusting sulphur, 5 parts of lead aresenate, and 15 parts of hydrated lime. (4) Three weeks after the third application; same as for (3). For best results, apply the dust either early in the morning when the air is still, or late in the evening.

3. Apply lead arsenate only when the foliage is dry and the temperature high.

4. Bordeaux mixture should never be used as a summer spray on peaches or plums.

5. Commercial oil emulsions vary in the percentage of oil they contain. For this reason, follow the recommendations of the manufacturer as to the amount to use, or consult the county agent.

(6) *Mixing directions for sprays:* Dissolve the zinc sulphate in water first; add lime and stir thoroughly, then add the other ingredients such as lead and wettable sulphur.

PEAR

Fire Blight

Fire blight, which is caused by Bacteria (*Erwinia amylovora*) is by far the most serious disease of pears and apples. It is because of the blight that the most desirable varieties of eating pears, such as the Bartlett, which is very susceptible, cannot be grown successfully in the State.

Symptoms: Blight is most conspicuous during blooming time. The blossoms and the leaves next to them turn black. The tips of twigs and branches die back, and the killed leaves which are dark brown to black in color remain hanging (Fig. 28). Bark cankers of various sizes form on branches and stems, or even on the main trunk of tree.

Control: Under the warm, humid conditions of our State, control of fire blight is very difficult. In regions with drier climates the blight can be kept in check by removing and burning the blighted twigs and by scraping the cankers on the branches and painting the wounds. This practice has been tried in Louisiana and has not proved effective. Furthermore, blight affects other related plants such as apple, crab apple, loquat (Japanese plum), pyracantha, etc., and the bacteria are spread by insects, especially bees over long distances. For Louisiana conditions, the following recommendations will be found helpful.

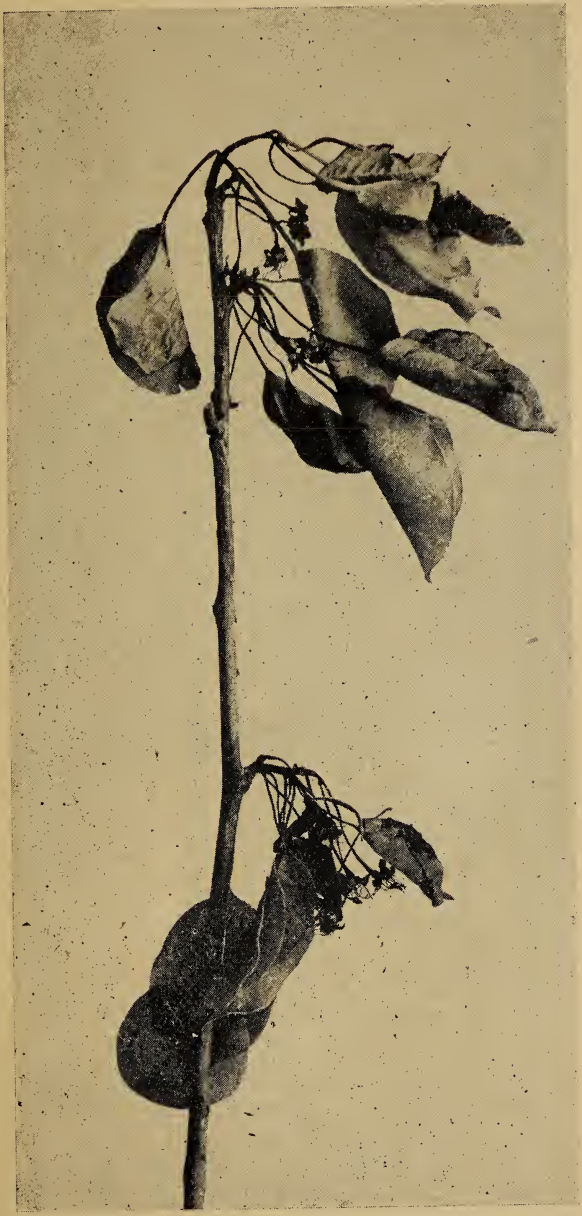

FIGURE 28.—Fire Blight on Pear. Note that the Blighted Leaves and Blossoms Turn Black and Remain Hanging on the Twig.

1. *Resistant varieties:* The Pineapple variety is practically immune to blight. Unfortunately, this is of a very poor quality as an eating pear, although it is fairly satisfactory for cooking and for preserving. The Hood, the Garber, the LeConte, and the Kieffer, which are of better quality than the Pineapple, show a certain degree of re-

sistance to blight, and, in general, can be grown successfully, although in some years these may blight badly.

2. *Spraying:* Spraying while the trees are in full bloom with 1-3-50 Bordeaux mixture has been found effective in the North, and it is reasonable to assume that it will prove helpful here for checking the blight on such varieties as the Hood, Garber, Kieffer, and LeConte, and also on apples. It is not necessary to spray the Pineapple, for this variety is practically immune.

3. *Cultural practices:* The blight bacteria prefer tender, succulent growth. For this reason the more vigorous the tree the worse it will blight. Therefore, it is advisable not to over-fertilize, not to prune heavily, and not to cultivate the trees. This applies to both pears and apples.

Leaf Spots

Two leaf-spotting diseases, caused by two different fungi, occur commonly on pear. For convenience, these are termed here the "Early Leaf Spot" and the "Late Leaf Spot" and are discussed separately.

Early Leaf Spot

(*Fabraea maculata*)

The early leaf spot disease makes its appearance early in the spring, usually in April. The spots on the leaves are mostly circular in outline, dark-brown to nearly black in color, with purplish margins (Fig 29, A). Spotted leaves turn yellow and shed. Defoliation usually starts on the lower branches and progresses upward. As new leaves are produced on the defoliated branches, they in turn become infected and fall off. Thus the defoliation continues throughout the summer. It is common for the defoliated trees to bloom profusely in late summer or early fall, and to bloom only sparingly and set very little fruit the following spring. In some varieties (as the Garber for example) the disease affects the fruit also, causing black cankers and cracks on it.

Control: The early leaf spot fungus has many ways of overwintering. It produces two kinds of spores on the dead leaves on the ground. It also forms minute cankers on the bark of twigs and shoots from which spores arise in the spring. In Louisiana the first method of overwintering of the fungus is the most common. Infection in the spring starts from spores produced on dead leaves on the ground. With these facts in mind, the following recommendations are made for the control of this disease:

1. Remove the dead leaves from under the trees in the winter either by plowing them under or, better still, by raking and burning. This will eliminate the main source of infection.

2. Spray the tree either with Bordeaux or with some other copper compound. Sometimes Bordeaux will cause injury to the leaves, and so it is better to use some Bordeaux substitute, such as "Spray Cop," "Tri-Basic Copper Sulphate," "Coposil," "Cuprocide," "Copper Hydro," etc.

(See page 91). These compounds are available on the market. Since the copper content of these different compounds varies, follow the recommendations of the manufacturer as to the amount to use. Two spray applications, one about the middle of April and the second about 3 weeks later should prove sufficient, but if the disease is not checked, a third application about 3 weeks after the second, may be necessary.

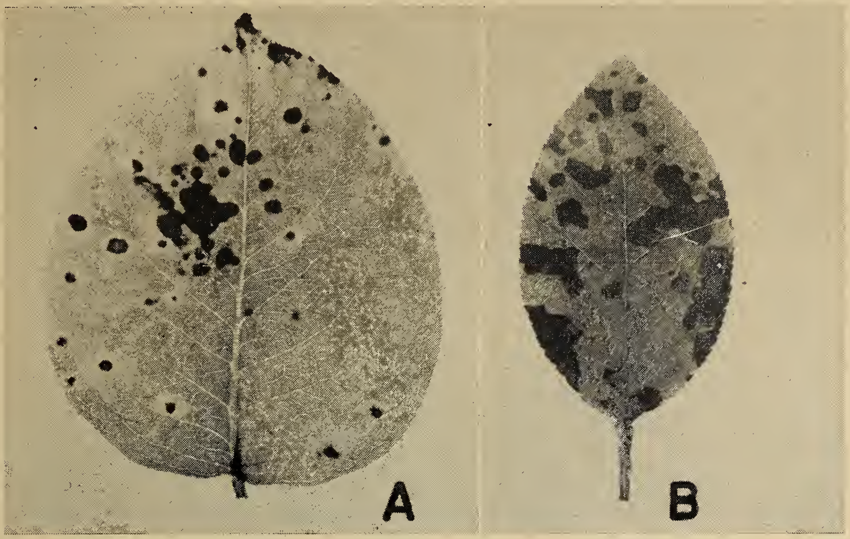

FIGURE 29.—LEAF SPOTS OF PEAR. A. EARLY LEAF SPOT (*Fabraea maculata*). B. LATE LEAF SPOT (*Cercospora minima*).

Late Leaf Spot

The late leaf spot disease is caused by another fungus (*Cercospora minima*). This disease makes its appearance late, usually in August. The spots are angular to indefinite in outline and brown to grayish in color (Fig. 29, B). When many spots develop on the leaves they turn yellow and shed, so this disease also causes defoliation.

Control: Since this disease appears late in the season, after the crop is over, it does not usually cause enough damage to justify control measures. However, if the infection is severe, or if it starts earlier than usual (under favorable conditions it may start in July), and it is found necessary to control it, the same kind of sprays recommended for the early leaf spot will be found effective.

Foot Rot

(*Clitocybe tabescens*)

During the summer (especially in late summer) pear trees are often seen with yellowish, unhealthy, wilting foliage. Such trees usually die before the end of the summer. Examination of trees thus affected will show that the bark of the trunk near the ground line and that of the crown and main roots is dead. A creamy-white, matted fungus growth occurs between the bark and the wood and between layers of the bark. The disease is caused by the oak-root fungus (*Clitocybe tabescens*), which attacks a very large number of woody plants. In Louisiana the disease has been found on pear, tung, peach, apple, weeping willow, grape, and rose. The fungus occurs naturally on the roots of various kinds of oaks, and when the land is cleared it persists for several years on roots which are left in the ground. This is the reason why foot rot is almost invariably found on trees which have been planted on recently cleared land.

Control: If the disease is discovered in time, before the bark has been killed completely around the trunk, the tree may be saved by scraping the killed part and painting the wound with Bordeaux paste. Unfortunately, by the time the tree becomes sick enough to be noticed, the trunk is usually completely ringed and then it is too late to save it.

Black Rot

(*Botryosphaeria ribis*)

About the time pears are approaching maturity, spots which are at first brown but soon turn black, usually appear on some of the fruits. These rot spots usually start at worm holes or at places where the fruit has been injured by birds, hail, wind, etc. The rot increases rapidly so that in a short period large areas on the fruit, or even the entire fruit, rot and turn black.

Black rot is caused by a fungus (*Botryosphaeria ribis*) which is very common in the South and which grows on cankers of branches and other dead or injured plant parts. Besides causing black rot of fruit, the fungus

Pear Spray Schedule

SPRAY NO.	TIME	Spray Mixture		For
1	Dormant	Oil emulsion Water	2 gals. 50 gals.	If San Jose Scale is present
2	Full bloom	Hydrated lime Copper sulfate Water	1½ lbs. 1½ lbs. 50 gals.	Blight (use only on varieties that blight) Omit on Pineapple pear
3	Calyx (¾ petals fallen)	Hydrated lime Copper sulfate Lead arsenate	3 lbs. 3 lbs. 1½ lbs.	Codling moth Leaf spot Blight
4	About middle of April	3-4-50 Bordeaux or with substitute copper compound (see page . .)		If early leaf spot is present
5	About middle of May	Same as for 4		If early leaf spot is present
6	Last part of July	Same as for 4		If late leaf spot is present

can cause cankers on branches and trunks of pear and other plants, especially following freeze injury. Another somewhat similar fungus (*Physalospora malorum*) which causes black rot of pear, apple and quince further north, also occurs in Louisiana but it is not common.

Control: Sanitary measures offer the cheapest method of control. Dead wood should be pruned and burned. Fruit that falls to the ground should be picked and removed from the orchard. Spraying for coddling moth (see spray schedule) will help to control black rot because much of the infection starts in holes of coddling moth worms. Spraying the fruit about 3 weeks before harvest with Bordeaux will probably prevent much of the black rot, but it is questionable if this is economically practicable.

PECAN

The pecan is affected by a very large number of diseases and insect pests. Only a few of the most common diseases are discussed here. For more complete information, write to the United States Department of Agriculture, Washington, D. C., for Farmers' Bulletin No. 1829 which contains a detailed account of all the diseases and insect pests of pecan and their control.

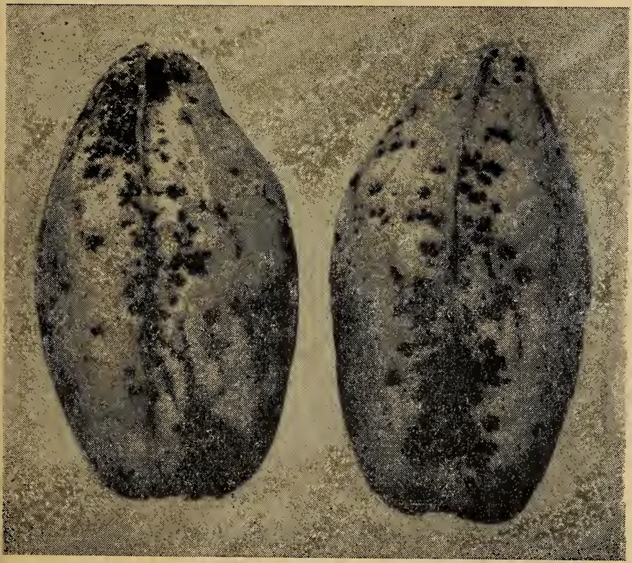

FIGURE 30.—PECAN SCAB.

Scab

Description: Scab, caused by a fungus, *Cladosporium effusum,* is by far the most important pecan disease, especially in the more humid southern half of the State. In the drier, northern part of Louisiana, scab is less troublesome. Scab affects the leaves, shoots, and nuts. The spots are circular or elongated, olive-brown to black in color, raised at first, but becoming sunken with age. When numerous, the spots unite to form irregular black blotches on the nut husks (Fig. 30). Badly scabbed nuts fail to fill and usually drop.

Control: Scab can be effectively controlled by spraying with a low lime Bordeaux mixture as follows:

First application: Spray with a 4-1-100 mixture (4 lbs. of bluestone, 1 lb. of lime, and 100 gallons of water) early in the spring when the leaves are one-fourth to one-half grown before pollination.

Second application: Spray with a 6-2-100 mixture (6 lbs. of bluestone, 2 lbs. of lime, 100 gallons of water) as soon as pollination is complete (when the tips of the small nuts have turned brown).

Third and fourth applications: The third spray should be applied about 3 to 4 weeks after the second, and the fourth spray about 3 to 4 weeks after the third. Use a 6-2-100 mixture.

If black aphids are present, add one-half pint of Black Leaf 40 (nicotine sulphate) to each 100 gallons of the spray mixture in the third and fourth spray applications.

Caution: If the temperature is low (55° F. or lower) when the first spray application is made, injury may result.

Resistant varieties: Pecan varieties differ widely in their susceptibility to scab. For home planting, where means of spraying large trees are not available, the planting of resistant varieties is the only practical way of avoiding scab. Unfortunately, some of the most desirable varieties from the point of view of quality of nuts, like the Schley, are very susceptible to scab. The Stuart is the most resistant variety, followed by Teche, Curtis, Nelson, Moore, Moneymaker, Frotscher, and Success in order of decreasing resistance.

The problem of selecting resistant varieties is further complicated by the fact that there are strains of the scab fungus in different localities which vary in their pathogenicity, so a pecan variety may be highly resistant to scab in one locality and susceptible in another. The best rule to follow is to plant varieties which have proved successful in your particular locality.

Leaf Blights

Under the general heading of "leaf blights" are included several diseases which cause leaf spotting and premature defoliation. Some of these are:

1. *Downy spot* (*Mycosphaerella caryigena*): Greenish-yellow, downy spots on the underside of the leaves earlier in the season, becoming visible on the upper side of the leaves as brown dead spots during the latter part of the summer. Delmas, Moneymaker, Stuart, and Frotscher are among the more susceptible varieties to this disease.

2. *Leaf blotch* (*Mycosphaerella dendroides*): The first signs of this disease are a greenish-brown, velvety, tufted growth in spots on the underside of the leaves and faint yellow spots on the upper side. This disease makes its appearance usually in late June or early July. Later in the season the velvety growth on the underside of the spots disappears, and minute, black, pimple-like structures appear on the affected surface. The spots enlarge and many unite to form large, irregular blotches. Severe defoliation occurs in late summer. The oldest leaves are shed first.

3. *Vein spot* (*Gnomonia nerviseda*) *:* The spots occur along the veins. Those along the midrib are long in shape; those originating near a smaller vein are circular. Spots also occur on the petioles (leaf stems) and on the stems of the leaflets. Severely affected leaves are shed prematurely. The Van Deman, Frotscher, and Stuart are among the most susceptible varieties.

4. *Brown leaf spot* (*Cercospora fusca*) *:* Circular to irregular reddish-brown spots, varying in size from one-eighth to one-half inch across. The older spots become grayish in color. This disease usually appears in July and the older leaves are affected first. In late summer the spotting increases rapidly and the trees become badly defoliated by the first part of October. All pecan varieties are susceptible to this disease, but the Stuart and the Moneymaker are the worst affected.

5. *Liver spot* (*Gnomonia caryae,* var. *pecanae*) *:* Dark brown circular spots on the lower surface of the leaves and located mainly along each side of the midrib. Later in the season the color of the spots changes to cinnamon-brown. This disease is more prevalent in the northern part of the State. Like the other leaf blights, liver spot causes premature shedding of leaves if the infection is severe.

Control of leaf blight: Organisms causing the leaf blights are relatively weak parasites, and for this reason the blights are more prevalent and more destructive on neglected or weakened trees which have not been adequately cultivated and fertilized. Strong, vigorously-growing trees are not damaged very appreciably. Proper care of the trees, adequate cultivation, and fertilization will in most cases be sufficient protection against the leaf blights. However, these diseases can also be easily controlled by spraying with Bordeaux mixture. If the trees have been sprayed for scab control (page 75) no additional spraying will be necessary. (See spray schedule for control of pecan diseases and insect pests, page 78) .

Rosette

(*Non-parasitic*)

Rosette is a nutritional trouble caused by zinc deficiency. This disease is characterized by a variety of symptoms. In early stages the leaves, especially those of the top branches, show a slight yellow motling. In more advanced stages the leaflets become narrowed, crinkled with reddish brown spots or holes between the veins. The internodes of the new shoots become shortened so that the leaves are borne close together, forming a bunched, rosetted type of growth. In still more advanced stages, there is a die-back of the shoots. In the more advanced stages the foliage, as a whole, has a bronzed or rusty appearance. Trees that are severely rosetted usually do not bear fruit.

Rosette is more prevalent on alkaline or neutral soils, on soils poor in organic matter, and on badly eroded soils, but may occur on other types of soil.

Control: Rosette can be easily corrected by the use of zinc (usually in the form of zinc sulphate). Zinc sulphate may be applied in three different ways—in the soil, in holes bored in the trunk, or as a spray.

Applications of zinc sulphate to the soil at the rate of ½ to 1 lb. for each year of the tree's age should be made in late winter (February or March). The chemical should be broadcast evenly under the tree, and it is well to disc it in. The soil application method has long-lasting effect. The only drawback to this method is that with certain soil types (alkaline soils especially) it does not work. Some soils have the power of immobilizing the zinc so that the roots cannot take it up. The soil-application method works well with acid soils.

Spray Schedule for the Control of Pecan Diseases and Insects[11]

NAME AND TIME OF SPRAY	For control of—	Materials	Remarks
First cover or pre-pollination spray. When first leaves are half grown.	Scab, downy spot, vein spot.	4-1-100 bordeaux mixture.	A very important disease spray.
Second cover spray. About time tips of small nuts have turned brown.	Scab, pecan nut casebearer, aphids, blotch, brown leaf spot, liver spot, vein spot, downy spot, rosette.	6-2-100 bordeaux mixture, nicotine sulfate 13 oz., zinc sulfate 4 lbs.	Important spray to protect the nuts and foliage. Cover nuts and leaves thoroughly. Use the zinc sulfate only if rosette is present. Important spray for pecan nut casebearer and should be applied at the proper time to obtain good results.
Third cover spray. 3 weeks after second cover spray.	Scab, aphids, blotch, brown leaf spot, vein spot, liver spot, rosette.	6-2-100 bordeaux mixture, nicotine sulfate 6 oz., zinc sulfate 4 lbs.	As the black pecan aphid infests the foliage on all parts of pecan trees, thorough applications are necessary. Use zinc sulfate only if rosette is present. If the fall webworm or the walnut caterpillar is usually abundant and a serious pest, add 2 lbs. of calcium arsenate.
Fourth cover spray. 3 weeks after third cover spray.	Scab, pecan leaf casebearer, aphids.	6-2-100 bordeaux mixture, calcium arsenate 2 lbs., nicotine sulfate 6 oz., zinc sulfate 4 lbs.	On varieties that do not scab and where it is necessary to control the pecan leaf casebearer, use 2-1-100 bordeaux mixture and 2 lbs. of calcium arsenate. Bordeaux mixture is used in this case as a corrective for arsenical injury.

A second method is to bore holes in the trunk and insert zinc sulphate in them. Holes 7/16 of an inch in diameter and 2½ to 3 inches deep are bored at intervals of about 4 to 6 inches spirally around the trunk. A heaping teaspoonful of dry zinc sulphate is inserted in each hole, and the holes are then plugged with cork stoppers. This method should be used only where it is known that soil applications are not effective and where the trees cannot be sprayed, for boring the holes in the trunk injures the trees somewhat.

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[11] This schedule has been copied from United States Department of Agriculture Farmers' Bulletin No. 1829, with changes recommended by Dr. J. R. Cole.

Where facilities are available for spraying, the easiest and cheapest way to control rosette is to spray with zinc sulphate at the rate of 2 to 4 lbs. per 100 gallons of water. Where spraying for the control of scab or other diseases or insect pests is practiced, zinc sulphate may be mixed with the other spray materials. See spray schedule.

STRAWBERRY

Leaf Diseases

Leaf spot: The leaf spot disease (which locally is called "rust") is caused by a fungus (*Mycosphaerella fragariae*) which enters the leaf and kills some of the leaf tissues. When the spots first appear they are small and purplish, but the typical mature spot has a grayish to white center with a reddish border and is about one-eighth of an inch in diameter. In the spring when infection occurs on rapidly-growing, tender foliage the spots are light-brown in color and have no reddish borders. In cases of severe infection the spots are so numerous that they cover the greater part of the leaf area and often kill the leaf (Fig. 31). Spots occur also on

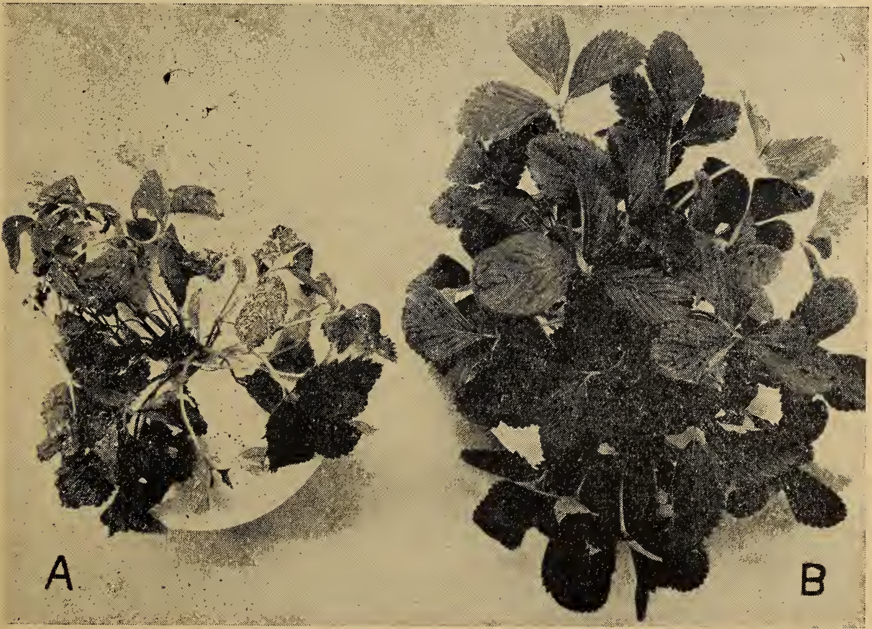

FIGURE 31.—Strawberry Leaf Spot. Contrast Between Sprayed and Non-Sprayed Plants from the Same Field at the End of the Harvesting Season. A. Non-Sprayed. B. Sprayed.

the petioles, on the fruit stalks, on the calyces, and occasionally on the green berries. The leaf spot is by far the most important disease of the strawberry in Louisiana.

Control: See page 81.

Leaf scorch: The scorch is caused by another fungous parasite, *Diplocarpon earliana.* Scorch makes its appearance first as minute purplish spots on the upper surface of the leaf. The spots enlarge rather rapidly, forming angular to irregular spots or blotches (Fig. 32). The centers of the scorch lesions never become gray or white. In this respect scorch differs from the leaf spot ("rust"). When infection becomes general the leaves "scorch," that is, they dry up as if scorched by fire. The disease also occurs on the petioles, fruit stalks, and calyces. The calyces dry up, making the fruit very unattractive. The scorch is much less common than the leaf spot in Louisiana.

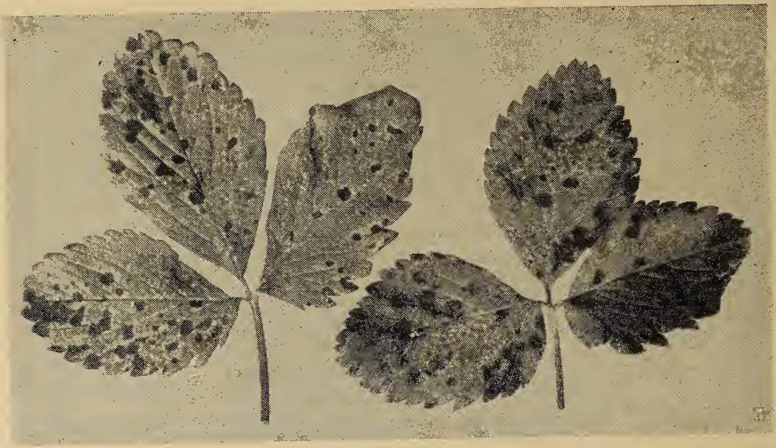

FIGURE 32.—STRAWBERRY LEAF SCORCH.

Control: See page 81.

Purple leaf spot: The symptoms of this disease are almost identical with those of the leaf scorch, but the disease is caused by a different fungus, *Mycosphaerella louisianae.* This is of relatively small economic importance.

Control: See page 81.

Angular leaf spot (leaf blight): The spots are large, first purplish, then brown in color, and usually, but not always, triangular in shape, their margins being delimited by the larger leaf veins. This disease caused by the fungus *Dendrophoma obscurans* occurs for the most part during the hot summer months when the plants are in a weakened condition. It does very little damage.

Cercospora leaf spot (Cercospora sp.): The spots are small (smaller than those of any of the other leaf diseases) and round. They are purple when young, becoming white with purplish borders when older. This disease also occurs only during the summer months and is of minor importance.

Control of leaf diseases: The following measures are recommended for the control of the strawberry leaf diseases.

1. *Spray:* All leaf blights can be controlled by spraying with 2-2-50 Bordeaux mixture. It is recommended to begin the spraying the latter part of January and spray about every 10 days until the fruit begins to ripen. It is also advisable to spray the plant beds in late summer and fall. If the plant beds have been sprayed so that the fall planting has been made with healthy plants, the winter spraying may be delayed until about the middle of February. "Spray Cop" at the rate of 3 lbs. in 50 gallons of water has been tried and has given as good control as Bordeaux. It is probable that others of the "fixed copper" compounds (see page 91) will be found effective.

2. *Sanitation:* Since the two main leaf blights, the leaf spot and the leaf scorch, do not spread very rapidly during the hot summer months, these can be almost completely eliminated from the plant bed by sanitary measures. In early June the plants that have been selected for plant production should be gone over carefully and all the old, spotted leaves should be removed and burned. This procedure should be repeated once or twice during the summer. This method of obtaining clean plants is especially effective with isolated small patches in home gardens.

3. *Resistant varieties:* The Klonmore (630) variety, which was developed by the Louisiana Agricultural Experiment Station, is highly resistant to both the leaf spot ("rust") and the leaf scorch. It is not necessary to spray this variety.

Crown Rot

Description: Crown rot, which is caused by a soil-inhabiting fungus (*Sclerotinia sclerotiorum*), some years causes serious damage to strawberry fields. The fungus attacks the plant at the crown. The bases of the leaves are killed and the leaves damp-off. The plant may be killed outright or it may recover. Recovering plants push out a number of secondary buds below the killed crown and produce small, spindly leaves.

Usually, but now invariably, numerous hard black bodies, the sclerotia, are found on the decaying parts of the plant. The sclerotia constitute the resting stage of the fungus, and they remain inactive in the soil during the summer months. The crown rot fungus is a cool weather organism and the disease is favored by prolonged cool, cloudy, rainy, or foggy spells in late winter and early spring. As soon as the weather warms, the disease disappears. The disease is worse during years in which the plants have been injured by freezes. The crown rot fungus attacks not only the strawberry but also a very large number of other plants.

Control: No practical method of control is known.

Dwarf

The dwarf disease, which also goes by such local names as "blind plant," "wild plant," etc., is caused by the bud nematode, *Aphelenchoides fragariae.* The nematodes occur in large numbers inside the buds and produce the injury by feeding on the young unfolded leaves.

The symptoms of dwarf are very striking. The leaves are narrow, brittle, twisted, varying in color from somewhat bronzed to even deeper green than the healthy ones. The petioles are very short, and the young leaves are greatly reduced in size. Usually, all the runner plants from a dwarf mother plant are diseased. Dwarf is a summer disease, the symptoms disappearing during late fall and winter. The reason for this is that the nematodes are inactive during the cold months.

Control: Even though dwarf is not a serious disease in Louisiana because the diseased plants recover during the winter and produce fruit in the spring, it causes injury to plants and a certain degree of reduction in yields. The disease can be easily kept in check by digging and destroying the diseased plants during the summer and early fall.

Root Knot

Root knot is caused by another nematode (*Heterodera marioni*) different from that causing the dwarf. Root knot occurs only very rarely on strawberries in Louisiana, and it is of no economic importance.

Berry Rots

There are several fungi which can cause rotting of the berries in the field if conditions for their development are favorable during the picking season. Warm wet weather, especially if prolonged for several days, is very favorable for the development of berry rots. When such weather prevails during harvest the losses from fruit rots are tremendous because the rots not only destroy the berries in the field but they affect the market price of the fruit, for the rots continue to develop in transit. On the other hand, if cool dry weather prevails during the picking season, losses from rots are neglible.

The following different kinds of berry rots are the most common ones in Louisiana.

Gray mold (*Botrytis sp.*) *:* This is one of the most common berry rots. It starts as a soft brown spot, usually on the side next to the ground or where a berry touches another rotten berry, which soon enlarges and covers the entire berry. After the berry is completely rotted, it dries up and its surface becomes covered with a gray powder, the spores of the fungus.

Tan rot (*Pezizella lythri*) *:* This is the most common and the most destructive berry rot in Louisiana during rainy weather. It starts as a tan-colored spot, often very inconspicuous. Later the rotted part of the berry becomes sunken, and it separates easily from the sound part of the berry.

Leather rot (*Phytophthora cactorum*) *:* This rot is not generally common, but occasionally it assumes epidemic proportions in certain fields and causes severe losses locally. In the spring of 1940 this rot destroyed about 50 per cent of the fruit in some localized fields. It affects both green and ripe berries. The texture of the rotted berries is tough and leathery, and the taste is bitter. This characteristic makes it easy to distinguish this from other kinds of berry rots.

Hard rot (*Rhizoctonia sp.*) *:* This is the least common and the least destructive of the berry rots. It affects berries that touch the ground, forming a hard, brown rot, usually with soil particles adhering to it, on one side of the berry.

Control: Berry rots are difficult to control. The fungi causing these rots live in the soil and on dead plant parts. Spraying has been tried and it has given a certain degree of control, but it is obviously impractical to spray when the fruit is ripe or nearly ripe, because of the objectionable spray residue. Heavy mulching, so that the fruit will be kept high above the ground and well ventilated is the most practical means of keeping the losses from fruit rots to a minimum.

Section III. Some Methods and Materials Used in Plant Disease Control

The plant pathologist has many different methods and many different chemicals at his disposal for the control of plant diseases. No attempt is made in this poplar bulletin to list or describe all the methods and chemicals employed in plant disease control. Only the ones most commonly used, and particularly the ones which are applicable to the diseases of the crops treated in this bulletin, are considered. It should be stated at this point that some of the chemicals used in the fight against diseases are either unobtainable, or are available in only limited quantities, during the present war emergency. It is hoped, however, that the usefulness of this handbook will extend beyond the period of war emergency and, for this reason, the most useful methods of chemical control of plant diseases are included even though some of the chemicals may be unobtainable at present.

SEED TREATMENTS[12]

Various methods have been devised for treating seed. The purpose of seed treatment is twofold, first to kill the pathogenic organisms that are carried on or in the seed, and second to protect the plant against pathogenic organisms in the soil. Damping-off of the seedlings is one of the most common and most serious diseases caused by soil-borne parasites.

The term "damping-off" is used to designate a disease of plants in the seedling stage. Two distinct phases of damping-off are recognized, namely, *pre-emergence damping-off* and *post-emergence damping-off*. In the first phase, the seed and young seedlings rot in the soil and never reach the surface; in the second phase, the stems of the young plants rot at the soil line, and the plants collapse and die suddenly. With some plants, a seed treatment is sufficient to give protection against both pre-emergence and post-emergence damping-off; with others two treatments, a seed treatment and a soil treatment, are necessary for satisfactory control of the two phases.

It is also very important to make clear the distinction between seed treatments designed to control damping-off, which is caused primarily by *soil-borne* parasites, and treatments designed to control *seed-borne* diseases, because the same treatments will not always control both. For example, the mercuric chloride treatment of cabbage seed will control the black rot disease, which is seed-borne, but will not protect the seed against damping-off. It is necessary to re-treat the mercuric chloride-treated seed with zinc oxide or Vasco 4 for protection against damping-off.

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[12] For more complete information on various seed treatments see U. S. Department of Agriculture Farmers' Bulletin No. 1862 and Louisiana Agricultural Experiment Station Bulletin No. 349.

With these preliminary remarks in mind, we can proceed to list and discuss some of the most common methods of treating vegetable seeds for the control of seed-borne and soil-borne diseases.

1. **Mercuric Chloride (Corrosive Sublimate):** This chemical is most commonly used in the concentration of 1 part in 1000 parts of water. Unless a large volume is required, it is most convenient to buy corrosive sublimate in the tablet form (it can be purchased at any drug store) for one tablet dissolved in 1 pint of water makes a 1-1000 solution. For larger volumes of solution, use 8 tablets to 1 gallon or 60 tablets (1 ounce) to 7½ gallons.

Caution: Mercuric chloride is a deadly poison and great care should be used in handling it and in disposing of it after it is used. It should be kept away from children and farm animals. Also, the chemical is corrosive to metals and it should never be dissolved in, or placed in, a metal container. Use wooden, glass, enamel, or earthenware containers.

Crops That Can Be Treated with Mercuric Chloride

Cabbage, cauliflower, collard, broccoli, brussels sprouts, and other crucifers: Soak seed in 1-1000 solution for 20 to 30 minutes, wash thoroughly in running water, or in several changes of water, and spread out to dry. This treatment will control black rot, but will not control damping-off. Therefore, before planting, coat the dry seed with zinc oxide or Vasco 4 (see treatment No. 4).

Pepper: Use 1-1000 solution. Soak seed for 5 to 6 minutes, wash thoroughly in several changes of water, and spread out to dry. Pepper seed is sensitive to mercury, and some injury to germination may result. This treatment is for the control of bacterial blight. To control damping-off, treat the dried seed with Cuprocide (treatment No. 3).

Irish potato: For Louisiana conditions the hot formaldehyde method (page 88) is recommended for treating seed potato tubers. In some areas of the country, mercuric chloride is used for treating seed potatoes. The following two methods are used:

(a) Cold mercuric chloride, 1-1000. Soak tubers (uncut) for 1½ hours. Plant immediately, or dry and store.[13]

(b) Acid-mercuric chloride (6 ounces to 25 gallons of water plus 1 quart of commercial hydrochloric acid). Dip seed for 5 minutes, plant immediately, or dry and store.[13] Do not store while wet. Twenty-five gallons of the solution will treat effectively about 40 bushels of potatoes, after which a new solution should be prepared.

Sweet potato: Use 1-1000 solution. Soak the potatoes for 8-10 minutes, then bed without washing. This treatment kills the spores of the black rot fungus (and of other pathogens) on the surface of the potatoes, and thus it helps to keep the disease in check. It does not kill the infection inside the potato, and so it does not provide complete protection against the black rot.

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[13] Mercuric chloride is a deadly poison. Treated tubers should not be used for food or feed.

The seed certification service of the State Department of Agriculture requires that, for the production of certified sweet potato seed or plants, the potatoes be treated with mercuric chloride before bedding.

2. **Organic Mercury Compounds:** There is a long list of organic mercury compounds, sold under different trade names, which are used for disinfecting various kinds of seed. Two of these, "Semesan" and "New Improved Semesan Bel" are the ones most commonly used for treating vegetable seeds.

Semesan: This chemical may be used either as a dust to coat the seed, or in the liquid form in which the seed are soaked.

(1) Dust: Use Semesan dust at the rate of ½ level teaspoonful per pound of seed for the following: beet, broccoli, brussels sprouts, cabbage, cauliflower, collard, carrot, cucumber, cantaloupe, eggplant, mustard, pea, radish, spinach, squash, Swiss chard, turnip, and watermelon.

For onion, parsley, and tomato, use the dust at the rate of ¼ level teaspoonful per pound of seed.

Place the seed and the dust in a tight container and shake well until the seeds are thoroughly coated. Screen off the excess dust. Plant immediately, or store in a dry place.

Notes: (a) The Semesan treatment cannot be used as a substitute for mercuric chloride (corrosive sublimate) treatment of seed of cabbage, cauliflower, broccoli, collard, brussels sprouts, and other crucifers for the control of black rot. However, for controlling damping-off in the seed bed (or in the field, if the seed is planted directly in the field) the seed which has already been treated with mercuric chloride can be re-treated by dusting either with Semesan or with zinc oxide (treatment No. 4, page 88). (b) Under certain conditions (planting in dry soil, for example) Semesan may cause injury to the treated seed. Therefore, for such seeds as tomato, pepper, eggplant, beet, carrot, pea, spinach, etc., which are copper-tolerant, the copper oxide treatment (page 87) should be used in preference to Semesan.

(2) *Liquid form:* Soak the seed in a solution made by stirring 1 ounce of Semesan in 3 gallons of water (1 level tablespoon in 1 gallon of water). The time of soaking varies from 15 minutes to 1½ hours, depending on the kind of seed to be treated. Follow the directions on the container.

The liquid Semesan treatment is recommended especially for pepper seed for the control of the bacterial blight (see page 28). Soak the pepper seed for 1½ hours, drain, and spread out to dry before planting.

New Improved Semesan Bel: In some parts of the country this chemical is used instead of the hot formaldehyde for treating seed potatoes, even though it is not so effective as the hot formaldehyde. For Louisiana, the hot formaldehyde method (page 88) is recommended for treating seed potatoes. However, if one buys seed that has not been treated with hot formaldehyde, one can treat it with New Improved Semesan Bel. The method is easy and cheap.

Directions: Mix 1 pound of the powder with 7½ gallons of water. Dip (do not soak) the uncut potatoes in this solution, drain, cut, and plant immediately.

Caution: The organic mercury compounds are very poisonous and should be handled with care. In treating seed with the dust it is preferable to work outdoors and to avoid breathing the dust. Treated seed should be kept away from farm animals. Treated potatoes should not be used for food or feed.

3. Copper Oxide: This is one of the most useful and most widely used chemicals for the control of damping-off the seedlings of many different vegetables and flowers. The material is made by different chemical companies, and is sold under different trade names (Cuprocide, Curedamp, Metrox, etc.). It varies in color from red through yellow and brown to black. For vegetable seed treatment, only the red and the yellow should be used.

Directions for use: Place the seed to be treated in a tight container, add the copper oxide powder at the rate of 1½ level teaspoonsful per pound of small seed (such as tomato, pepper, eggplant) and ½ teaspoonful per pound of large seed (such as pea), shake well until all seeds are thoroughly coated, then screen off the excess powder. Treated seed may be planted immediately, or it may be stored if kept dry.

Caution: Seed treated with copper oxide should not be planted in pure sand or in soil too dry for good germination, for under these conditions injury may result.

If the seed is to be planted by a drill, add a small amount of graphite powder (½ as much by weight as the copper oxide) at the time the seed is treated. Graphite acts as a lubricant and prevents clogging of the drill.

Seeds that are benefited by the copper oxide treatment: beet, carrot, celery, cucumber, eggplant, muskmelon, pea, pepper, pumpkin, romaine, spinach, squash, Swiss chard, tomato, calendula, cosmos, pansy, salvia, zinnia.

For all the above-named seeds, *except eggplant,* seed treatment alone is usually sufficient to prevent both pre-emergence and post-emergence damping-off. However, if the seedlings begin to damp-off after emergence, the disease can be stopped either by watering the plants once or twice with a suspension made with 1¼ oz. (6 level teaspoonfuls) of copper oxide to one gallon of water, or by coating the surface of the soil with a layer of zinc oxide or Vasco 4 (see treatment No. 4). The two last named materials can be applied to the soil surface by means of a large salt shaker or by means of a perforated tin can. Use at the rate of about 2 ounces per 3 square feet of soil. Care should be taken not to break this layer on the soil surface.

In the case of eggplant, the copper oxide treatment of the seed will control the pre-emergence phase of damping-off but will not protect the young seedlings against the post-emergence phase of the disease. For this reason, eggplant seedlings should either be watered with a copper oxide suspension in water, or the soil surface should be covered with a layer of zinc oxide or Vasco 4.

Seeds that are likely to be injured by copper oxide: Seeds of crucifers (cabbage, cauliflower, collard, brussels sprouts, broccoli, turnip, radish, etc.) are sensitive to copper injury, and should not be treated with copper oxide. These seeds should be treated with Vasco 4 or zinc oxide (see treatment No. 4) if they are to be planted in the seed bed, or with Semesan (see page 86) if they are to be planted in the field.

Lettuce seed is sometimes injured by copper oxide. Onion and corn usually are neither injured nor benefited by the copper oxide treatment.

4. **Zinc Oxide and Vasco 4:** Zinc oxide and Vasco 4 (a mixture of zinc oxide and zinc hydroxide) are very useful substances for combating damping-off. These chemicals are used in two ways, (1) to treat the seeds directly for control of pre-emergence damping-off, and (2) to coat the soil surface after the seedlings emerge to control the post-emergence phase of damping-off. They are especially useful for treating such copper-sensitive seeds as those of the cabbage family and for treating the soil surface of eggplant seed beds.

Directions for using zinc oxide or Vasco 4: For seed treatment, place the seed and either zinc oxide or Vasco 4 at the rate of 2 level teaspoonfuls to the pound of seed in a tight container and shake well until all the seed are well coated with the dust. Screen the seed to remove the excess dust. Plant immediately, or store dry.

For soil treatment, either zinc oxide or Vasco 4 should be applied to the surface of the soil at the time the seedlings are emerging. Use at the rate of about two ounces every 3 square feet of soil surface. Leave the layer of chemical on the soil surface undisturbed.

5. **Formaldehyde:** This chemical is used in either liquid or dust form for treating seed and for disinfecting soil.

For treating seed potatoes the hot formaldehyde method is extensively used. A solution is made by mixing 1 quart of commercial formalin (40% formaldehyde) with 30 gallons of water which is kept at a temperature between 124° and 126° F. while the potatoes are being treated. The potatoes are dipped in this solution for 4 minutes, then are removed and spread out to dry. After treating every 50 bushels of potatoes, 0.9 of a pint of formaldehye should be added to the tank of solution to compensate for loss of strength.

6. **The Hot Water Method:** The hot water treatment is a most effective method of disinfecting seed because it kills seed-borne pathogens both on and in the seed. At the same time, this method is very drastic, and unless due care is exercised in controlling the temperature of the water, in correct timing of the treatment, and in drying the treated seed,

the germination of the seed may be considerably impaired. This is especially true in the case of old or weak seed. For this reason, the hot water treatment is recommended only for those seed-borne diseases against which no other effective treatment is known. For Louisiana, the hot water method is recommended only for treating seed of cabbage, cauliflower, brussels sprouts, and other crucifers for controlling the black-leg disease. As has been explained in the text (page 12), seed grown in the Puget Sound district is usually free of infection and requires no treatment for the control of black-leg. If the seed has been grown in a region in which black-leg is known to occur, it would be advisable to treat it with hot water.

Directions: Place the seed in a loosely-woven cloth bag, which should be only about one-half full, and immerse it in hot water at a temperature of 122° F. Keep the water stirred during the operation and have extra hot water handy to add to it as it begins to cool, in order to maintain the temperature at 122° F. After the required exposure, remove the bag and plunge it in cold water to cool the seed quickly. Drain, and plant immediately, or spread the seed out to dry. Quick drying is essential.

Cabbage seed should be treated for 25 minutes; seeds of cauliflower, brussels sprouts, broccoli, collard, kale, kohlrabi, and turnip for 15 to 18 minutes.

SPRAYS AND DUSTS

Most of the sprays and dusts used for the control of plant diseases contain either copper or sulphur as the active fungicide ingredient. The number of different kinds of sprays and dusts is very large. Only the ones most commonly used, and especially those which are recommended for the control of the diseases of crops considered in this bulletin, will be described.

Copper Compounds

1. *Bordeaux Mixture:* Bordeaux mixture is made with copper sulphate (bluestone), lime, and water. In writing the formula for Bordeaux, the amount of bluestone (in pounds) is given first, the amount of lime (in pounds) second, and the amount of water (in gallons) third. Thus, a 4-2-50 formula means 4 lbs. of bluestone, 2 lbs. of lime, and 50 gallons of water. Bordeaux mixture is relatively easy to make, and yet certain care is necessary in its preparation. To make 50 gallons of the standard 4-4-50 Bordeaux, the following method will be found satisfactory.

(a) Fill a 50-gallon wooden barrel about 2/3 full of water. Put 4 lbs. of bluestone in a sack, or cloth bag, and suspend it in the water to dissolve. Bluestone dissolves very slowly if placed at the bottom of the barrel, but rather rapidly (20-30 minutes) if suspended near the top of the water. Never dissolve bluestone in a metal container because it corrodes metals, and it will not only ruin the container, but will change the chemical composition of the spray mixture.

(b) Place about 10 gallons of water in another container, and stir into it 4 lbs. of fresh hydrated lime. Stir well to make a fine, milky suspension. Lime does not corrode metals and so a metal container such as galvanized iron wash tub may be used for the lime suspension.

(c) After the bluestone has dissolved, pour the lime suspension into it and stir. Add enough water to bring the volume of the mixture to the 50-gallon mark. The spray mixture is now ready to use.

Quicklime (rock lime) may be used instead of hydrated lime. In fact, quick lime is better than hydrated lime because Bordeaux mixture made with quicklime is more gelatinous and more adhesive than that made with hydrated lime. However, quicklime is not only difficult to obtain (unless bought by the barrel) but also difficult to keep, for unless it is kept in an air-tight container, it will air-slake and become unfit for use. For this reason, the use of hydrated lime is recommended. Most of the brands of hydrated lime sold in Louisiana are suitable for making Bordeaux if used while fresh.

Bordeaux mixture deteriorates rapidly, and for this reason it should be used the same day it is made.

If large amounts of Bordeaux are to be made it is convenient and time-saving to prepare stock solutions of bluestone and lime. The most convenient concentration of each is 1 pound in 1 gallon of water. The two solutions should never be combined in the concentrated form. The spray tank or barrel should be filled about one-half full with water, the desired amounts of the stock solutions should be added and stirred, then more water should be added to fill the tank or barrel. For example, to make a 4-4-50 Bordeaux in a 200-gallon tank from stock solutions made with 1 pound of the materials per gallon of water, proceed as follows: (1) Fill the tank about one-half full and start the agitator. (2) Pour in 16 gallons of the bluestone stock solution and 16 gallons of the lime stock suspension. (3) Add more water to fill the tank.

The stock solutions, if kept separate, will keep indefinitely.

2. *"Instant" Bordeaux:* The so-called "instant" Bordeaux mixture is made from finely powdered copper sulphate, called "snow" or "flour," and hydrated lime. To make a 4-4-50 mixture, fill the 50-gallon barrel nearly full with water and add 4 lbs. of the powdered copper sulphate while stirring. The powder will dissolve in a few seconds. Make a suspension of the hydrated lime in 2-3 gallons of water in a bucket, pour it into the barrel, and stir for a few seconds. Add enough water to fill the barrel. The mixture is now ready to use.

The only advantage that "instant" Bordeaux has over the regular Bordeaux is the rapidity of its preparation, for the finely powdered bluestone dissolves almost instantly. The powdered bluestone, however, usually sells at a higher price than does the crystal form. Furthermore, it is necessary to keep the powdered bluestone in an air-tight container, otherwise it will "cake" and will not be easily soluble.

3. *Bordeaux Paste:* If Bordeaux mixture is prepared in the form of a thick paste, it makes an effective, safe, and cheap dressing for painting pruning wounds and other cuts on trees. It is made as follows: Dissolve 4 lbs. of bluestone in 3 gallons of water, slake 6 lbs. of quicklime with 3 gallons of water, and mix the two together. This makes a thick paste which can be applied by means of a brush. If quicklime is not available, use 8 lbs. of hydrated lime instead.

4. *Various "fixed" copper compounds:* In recent years several of the so-called "fixed" or "insoluble" copper compounds have come into use as substitutes for Bordeaux mixture for spraying, and also in the form of dusts. These compounds contain copper in some form, such as copper oxide, copper hydroxide, basic copper sulphate, copper oxychloride, copper silicate, copper phosphate, etc., and are sold under various trade names such as "Cuprocide," "Tri-basic," "Spraycop," "Basicop," "Coposil," "Cupro-K," "Copper Hydro-40," etc. A few of the compounds have been tested in Louisiana on certain crops, and have been found satisfactory. Many of these have not as yet been tested, so no general recommendations regarding their use can be made. Satisfactory results, however, have been reported for most of these compounds in other States.

Compared with homemade Bordeaux, the following advantages and disadvantages may be stated in general for the fixed compounds.

Advantages: (1) They come in powder form, usually in weighed packages, and they are easy to mix. All one has to do is put the required amount of the dust in the required amount of water, stir, and the mixture is ready to use. (2) Since these compounds contain, in general, less soluble copper than Bordeaux and no free lime, they cause less injury to the plant than Bordeaux.

Disadvantages: (1) In general, these compounds are less effective fungicides than Bordeaux. (2) They are less adhesive to foliage than Bordeaux. (3) They tend to settle in the spray tank. If the spray tank is equipped with an agitator, this point is not important, but if the sprayer does not have an agitator (as is the case with most of the small knapsack type of sprayers in use in Louisiana) the settling of the spray material is a serious drawback.

Several of these copper compounds are diluted with some inert filler, with or without the addition of insecticides, and used as dusts (see cucumber, pages 15 and 16).

Since the percentage of copper in these different compounds varies, follow the recommendations of the manufacturer as to the amount to use in preparing a spray or a dust.

Sulphur

1. *Dusting sulphur:* Sulphur possesses both fungicidal and insecticidal properties and is used effectively against such diseases as the powdery mildews, some rusts, brown rot of stone fruits, etc., and against red spider, rust mite, some leafhoppers, etc. The effectiveness of sulphur depends

on the fineness of its particles. Dusting sulphur should be 300 mesh or finer. Most brands of dusting sulphur meet this specification. Sulphur may cause injury on some plants, especially under hot and dry conditions.

2. *Wettable sulphur:* Sulphur by itself does not mix with water. However, if some wetting agent, such as glue, casein, or lime, is mixed with it, the sulphur becomes wettable and it can be used with water as a spray. Wettable sulphur is easily available on the market. If it is found desirable to prepare wettable sulphur at home, the following formula will be found satisfactory:

Dusting sulphur	2½ pounds
Casein	4 ounces
Water	1 quart
Water to make	50 gallons

Mix the casein in 1 quart of water to make a smooth paste, mix this with the sulphur, then add the rest of the water.

Instead of the casein, ⅜ ounce of glue dissolved in 3 quarts of water may be used as the wetting agent.

3. *Lime sulphur:* Lime sulphur is one of the most important sprays, for it is both a fungicide and an insecticide. It is made by boiling together quicklime and sulphur (50 lbs. quicklime, 100 lbs. sulphur, 50 gallons of water). Commercial brands of lime sulphur, both the concentrated solution and the dry form, are easily available and relatively cheap, so no directions are given here for home made lime sulphur.

Most commercial preparations of concentrated solutions of lime sulphur vary in density from 28° Beaumé to 33° Beaumé. For winter (dormant) spraying, this is diluted at the rate of 1 gallon of the concentrated solution in 8 gallons of water. For summer spraying, much more dilute mixtures are used, 1 gallon in 50 to 100 gallons of water, depending on the time of spraying and the kind of plant being sprayed. (Follow directions given in spray schedules for various crops).

Dry lime sulphur is made by the dehydration of the concentrated lime sulphur solution. Dry lime sulphur is less active than the liquid form, and so it is necessary to use more of it to make a spray that will be equivalent to that prepared with liquid lime sulphur. (Follow directions given in spray schedules for various crops).

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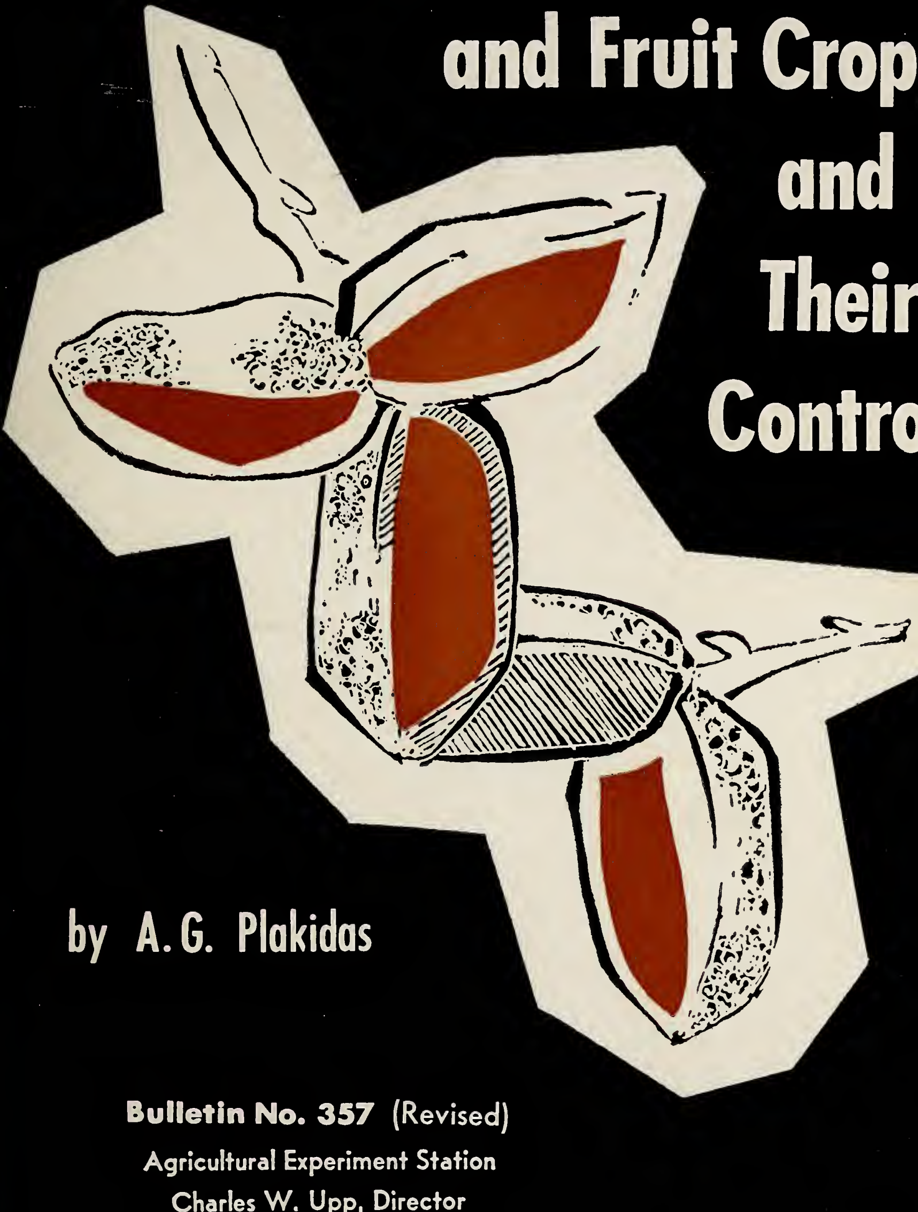
June 1957

Diseases of Some Vegetable and Fruit Crops and Their Control



by A. G. Plakidas

Bulletin No. 357 (Revised)

Agricultural Experiment Station
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Diseases of Some Vegetable and Fruit Crops and Their Control

A. G. PLAKIDAS

Introduction

This bulletin was first published in 1943. It became very popular because it came to fill a long-felt need for a convenient handbook for reference and use by county agents and farmers. The supply of the original printing has long been exhausted, but even before exhaustion it was felt that a revision was necessary. The organic fungicides, which have displaced to a large extent the copper and sulphur compounds as sprays and dusts, were unknown when the bulletin was first written. The disease situation in certain crops has changed during the past few years. For example, internal cork, which at present ranks as perhaps the most important disease of sweet potatoes, was unknown when the bulletin was first written. The same is true of *Tristeza* of citrus trees. Bacterial blights of beans, very important then, have been practically eliminated by the use of certified blight-free seed.

No attempt has been made to include all crops growing in Louisiana or all diseases of each crop. The important diseases of only the vegetable and fruit crops are considered. Consequently, some of the most important crops of the State, namely, sugarcane, rice, cotton, and corn, are not included.

Causes of Plant Diseases

It will probably be easier to understand the discussion of the individual diseases and their control if a brief, general account of the causes of plant diseases and troubles is presented first. The different causes of plant diseases and troubles are given in the following outline:

I. Parasitic Diseases
    1. Fungi
    2. Bacteria
    3. Nematodes
    4. Insects[1]

II. Non-parasitic Diseases
    1. Unfavorable climatic conditions
    2. Adverse soil conditions
    3. Noxious gases

III. Virus Diseases

Fungi are the most important plant-disease producing organisms. They are minute organisms composed mostly of a thread-like body (the "mycelium") and of microscopic fruits (the "spores"). The spores may, for convenience, be termed the "seed" of the fungi because it is by means of these organs that fungi are disseminated and infect the plants. Fungi cause many different kinds of diseases. They may attack the underground parts of the plant causing various root rots; they may attack the above-ground parts causing various cankers on the trunk and branches, rusts and mildews, leaf spots, blights of leaves and flowers, and various rots and molds of different fruits; or they may invade the vascular system of the roots and stems to produce wilting. The combating of fungous diseases is, therefore, a complicated process. It is necessary to know the life history of the particular fungus involved in order to know when to apply the fungicide to do the most good. Generally speaking, fungous diseases occurring on the above-ground parts of a plant are fairly easily controlled by sprays or dusts. The soil-inhabiting fungi which attack the roots and those that invade the vascular system of the stems are most difficult to control.

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[1] The injuries caused by insects are not considered in this bulletin. Information on insect pests of different crops can be obtained from the office of Extension Entomologist, Louisiana Agricultural Extension Division, Baton Rouge, Louisiana.

Bacteria are microscopic organisms much smaller than fungi. Like fungi, bacteria are capable of causing a great diversity of diseases. They, also, can invade the vascular system of plants and cause wilts. They can attack leaves, stems, shoots, blossoms, and fruit of different plants and cause serious blights (bean blight and fire blight of pears and apples, for example). In addition, bacteria can attack roots and crowns, which results in the formation of swellings and knots (crown gall). They can cause cankers on trunks and branches of trees, and various rots of fruits and vegetables. Bacterial diseases are much more difficult to control by sprays and dusts than are those caused by fungi.

Nematodes are microscopic animals (eelworms). The most common and most destructive species is the one that causes galls or knots on the roots of many plants (root knot nematode). However, not all species of root-feeding nematodes cause the formation of galls or knots on the roots. Some species invade the roots, causing death of the tissue without the formation of galls; others feed on the roots from the outside causing great damage. There are also species of nematodes that prefer to feed inside the crowns or buds of certain plants (see "strawberry dwarf," p. 109) and still others that attack leaves, stems, and flowers of different plants. The root knot nematode alone can attack a very large number of different plants (over 1200 kinds of plants are known to be affected) and it can survive in the soil outside the plants for a long time. Nematodes are very common in the South, especially in light sandy soils. They are very difficult to control.

Non-parasitic diseases are caused by adverse climatic or soil conditions, such as cold, heat, drought, poor drainage, unfavorable soil reaction (acidity or alkalinity), general infertility of the soil, lack of one or more of the "minor elements" (zinc, manganese, copper, boron, etc.) or excess of soluble salts, or the presence of a toxic substance in the soil, etc. In cities and in the vicinity of industrial plants, smoke and poisonous fumes may cause injury. Some of the herbicides (weed killers) and defoliants that have come into general use in modern agriculture often cause serious injuries (see Section IV, pages 128-131).

For convenience, virus diseases have been placed in a separate group instead of being included either among the parasitic or the non-parasitic causes, because it is not definitely known whether viruses are living or non-living. In some ways viruses behave like living organisms and in other ways like non-living chemical substances. What is known is that viruses are ultramicroscopic (they cannot be seen even with the strongest microscope) entities which, when introduced into the plant, increase and spread very rapidly, and produce specific diseases which are often very destructive. Virus diseases are spread chiefly by insects (aphids, leaf-hoppers, thrips, etc.) which feed on diseased plants and then on healthy ones, but some can also be spread mechanically during handling operations. Tomato mosaic, for example, is often spread during pruning and staking.

Viruses produce a great variety of symptoms depending on the kind of virus and often on the kind of plant. Some of these symptoms are green and yellow mottling of leaves (mosaic), general yellowing or chlorosis (yellows), dwarfing and stunting of the growth of the entire plant, distortion or rolling of leaves, dead spots on leaves or stems, etc. Often there is a combination of several of these symptoms.

Section 1. Vegetable Diseases

BEAN AND LIMA BEAN

The bean is subject to numerous diseases. The two most destructive diseases of bean in the past were anthracnose and bacterial blight. Neither of these is of economic importance now because satisfactory control of both anthracnose and bacterial blight has been attained by the use of western-grown seed. However, a brief description of both of these diseases is included in this bulletin because there is always the possibility of outbreaks if other than western-grown seed is planted.

Anthracnose

Symptoms. This disease, which is caused by a fungus *(Colletotrichum lindemuthianum)*, affects all parts of the bean—seed, stem, leaves, and pods. The spots on the pods are the most conspicuous symptom (Fig. 1). Mature spots on the pods are sunken in the tissue, black with brownish margins. In the presence of moisture the centers of the spots may become flesh-colored. On the stems the cankers are at first brown in color, later becoming black and sunken. The symptoms on the leaves are angular dead areas on the upper surface and blackening and killing of the veins on the under surface. The petioles are also affected.

Control. Control of anthracnose is based on the fact that the disease is seed-borne. The organism causing the disease does not survive the high temperatures of Louisiana summers. Therefore, if disease-free seed is planted in the spring, the beans will be free of anthracnose. In former years, when most of the bean seed planted in Louisiana was grown in the cool, humid, northern states (chiefly Michigan) bean anthracnose was very serious. In recent years, with the planting of western-grown seed (seed grown in the arid, irrigated areas of the West where anthracnose is not prevalent) the disease has been practically eliminated and it has ceased to be of economic impor-

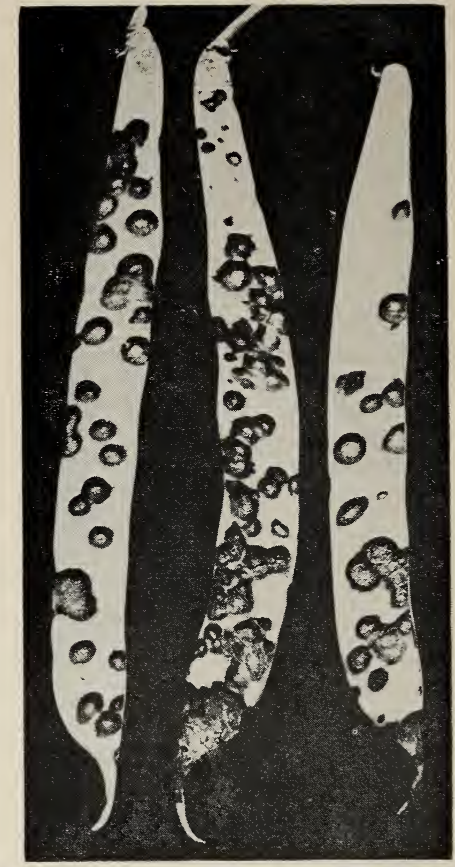

Fig. 1. Bean anthracnose. Symptoms on pods.

tance in Louisiana. This point should be kept well in mind in connection with the control of another seed-borne disease of beans, bacterial blight, which is discussed next.

Bacterial Blight

Symptoms. Several species of bacteria attack beans, causing blights. The most important ones are *Xanthomonas phaseoli,* the cause of common blight, and *Pseudomonas phaseolicola,* the cause of halo blight. These two blights differ in symptoms somewhat, the chief difference being that the dead spots on the leaf caused by the halo blight organism are surrounded by distinct yellow halos (Fig. 2), while those of the common blight are not. For practical purposes, however, and especially from the point of view of control, the two diseases may be treated as one because both have many things in common. Both are seed-borne. Both may affect all parts of the plant—seed, seedlings, stems, leaves, and pods of the mature plant; and both may be very destructive under conditions favorable for infection and spread. The spots on the leaves have a water-soaked (greasy) appearance at

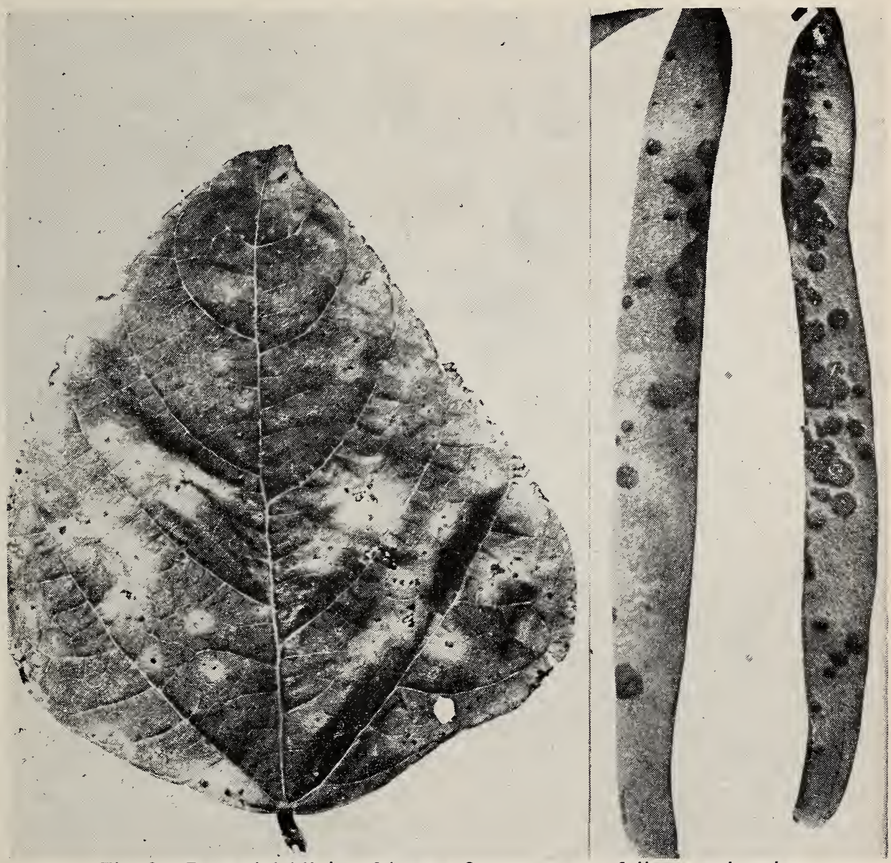

Fig. 2. Bacterial blight of beans. Symptoms on foliage and pods.

first, and in the case of halo blight, are usually surrounded by a yellow halo. Later the spotted leaf tissue dies and turns brown. When the spots are numerous, there are no distinct halos, but the entire leaf turns yellow. When infection starts early, the entire plant is severely stunted and may be killed outright. The spots on the pods also start as water-soaked (greasy) areas resembling sun-scald, but may become reddish-brown on drying. The spots may be separate and more or less circular, or may run together forming irregular water-soaked areas on the pod (Fig. 2).

Control. In discussing control for bean blight, the following facts should be emphasized: (1) The disease is seed-borne; (2) the bacteria occur *under* the seed coat where ordinary seed disinfectants cannot reach them; (3) sprays have not given satisfactory control; and (4) under Louisiana conditions the blight bacteria do not survive in the soil from one year to the next. With these facts in mind it is apparent that the logical way to control bean blight is to plant blight-free seed. Seed grown in the cool, humid northern states almost invariably contains a large percentage of blight infection.

About 15 years ago, it was discovered that bacterial blights did not occur in the dry areas of Sacramento Valley in California, where there is no summer rainfall and beans are grown under irrigation. The Plant Pathology Department of the Louisiana Agricultural Experiment Station, in cooperation with the University of California, decided to make a practical use of this discovery. Arrangement was made with certain California growers to produce seed of the bean varieties grown commercially in Louisiana for testing. Careful tests showed that California-grown seed was completely blight-free. This led to large-scale production of certified blight-free seed in California. All the commercial bean acreage in Louisiana is now planted with blight-free, California-grown seed. So successful has this project proved that bacterial blight, once the most destructive disease of beans, is no longer of economic importance and, in fact, is practically nonexistent in Louisiana and other Deep South states.

Caution. It is very important to remember that this California-grown seed is blight-free, not blight-proof. None of the commercial varieties of snap beans is blight-proof . . . not even blight-resistant. Plants from California-grown seed will blight if they come in close contact with plants grown from blight-infected seed. Therefore, never mix California-grown seed with seed from other sources. If enough seed is available, make all plantings with California-grown seed. If enough California-grown seed is not available and you have to use seed from other sources, plant the California-grown seed separately, removed by at least a quarter of a mile.

Bacterial Wilt

(*Corynebacterium flaccumfaciens*)

Like the blight organisms, the wilt bacteria are also seed-borne. They invade the vascular elements and plug or otherwise injure the vessels which conduct water from the roots to the top of the plants. The infected plant thus wilts and dies. If the plants become infected when two or three inches tall, they usually die; if infected later, they may take considerable growth before being killed. Infected plants wilt and droop, and their leaves hang limp, during the warm part of the day, but recover partially during the night or during humid cool spells. Most infected plants eventually die, although an occasional plant may survive to maturity. Quite often both blight and wilt occur together.

Control. Same as for blight; disease-free seed. California-grown seed is free of wilt bacteria.

Rhizoctonia Diseases

Rhizoctonia (Pellicularia), a fungus consisting of many forms or races (some of these are recognized as distinct species by many investigators), is very widely distributed, occurring in practically all soils, virgin and cultivated, and causing diseases of many crops. On beans, it causes the following distinct phases of disease:

1. **Damping-off.** The germinating seed before emergence, or the young seedlings after emergence, are attacked and killed. This phase is most likely to occur if unfavorable (cold, wet) weather conditions prevent quick germination of the seed and rapid growth of the young seedlings.

2. **Stem canker.** Elongated, sunken, reddish-brown cankers develop on the stem near the soil line (Fig. 3). The plant may be killed if the canker girdles the stem completely. Normally, the plant is not killed, but its growth is retarded and the yields are reduced. Losses of 5 to 20 per cent have been reported by different investigators.

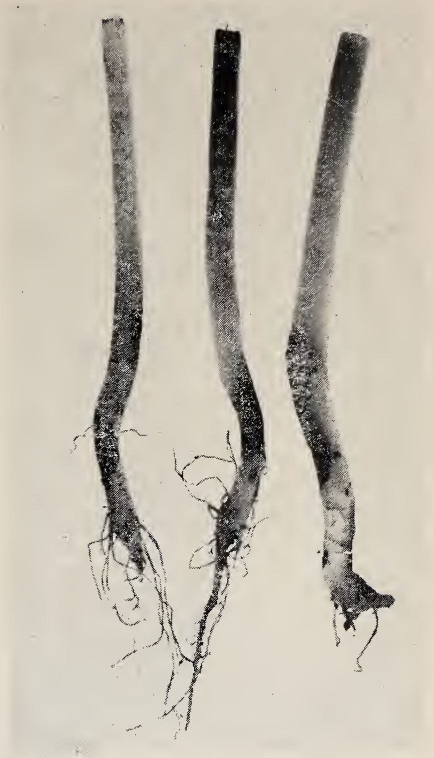

Fig. 3. Rhizoctonia stem cankers on bean.

3. **Pod canker.** When pods touch the soil or are close enough to the surface of the soil to be splashed with soil particles during heavy rains, a disease phase known as pod canker or soil canker often develops on the pods. The affected tissue decays, forming prominent sunken cankers of varying sizes.

4. **Web Blight.** The first symptoms of the disease include a scalding of some of the leaves, and the appearance of spots or cankers on the pods. Affected leaves

cling to other leaves or to stems, and when pulled apart it is seen that they are held together by means of a cobweb-like material. Later the whole plant may become blighted, and leaves and stems become peppered with minute, dark-brown bodies (the sclerotia of the web-blight fungus) which look somewhat like grains of sand.

Web blight can be an extremely destructive disease. In Florida it is considered one of the most serious diseases of this crop. Fortunately it does not occur in Louisiana every year. The first recorded outbreak of the blight in Louisiana was in 1940. The following year it destroyed about 75 per cent of the fall bean crop. Other severe outbreaks occurred in 1951 and 1955. Weather conditions have a decided influence on the development of this disease. The organism causing web blight is a form of *Rhizoctonia* that prefers the above-ground parts of various plants, in contrast to most forms of this fungus which attack mostly roots and other underground organs. It is considered by many mycologists as a distinct species, designated as *Rhizoctonia microsclerotia.* It thrives in hot, humid weather. It has never been observed on the spring crop of beans because the weather then is too cool for the fungus. It attacks the fall crop only in years with heavy and excessive rainfall in September and/or October.

Control. There is no easy, practical control for the Rhizoctonia diseases. The fungus is a common soil inhabitant, occurring even in virgin soils, and it attacks a very large number of non-related crops. Rotation, therefore, probably would not help. Coating the seed before planting with some fungicidal dust, such as Spergon or Arasan, aids germination and reduces to some extent the damping-off phase of the disease. It has been reported from Florida that a new organic fungicide, PCNB (pentachloronitrobenzene) applied in the furrow at the rate of 10 lb. per acre, reduced greatly the stem canker phase. Reports from other parts of the country indicate that PCNB is the most effective fungicide yet found against Rhizoctonia. This suggests that this material, as a soil application, may control all phases of Rhizoctonia diseases of beans. Whether or not this would be an economically practical control measure remains to be determined.

Rust

(Uromyces phaseoli typica)

Rust is one of the most destructive fungous diseases of beans in many regions of the country. In our State it occurs only rarely on bush beans and it is not a factor to be reckoned with in the commercial production of snap beans. However, rust attacks pole beans almost invariably in home gardens in the summer and fall. Rust is easy to recognize. It is characterized by the appearance of numerous small, orange-colored pustules which occur for the most part on the under surface of leaves (Fig. 4), but also on petioles, stems, and pods. Soon after the appearance of the spots, the leaves turn yellowish, dry up, and fall off.

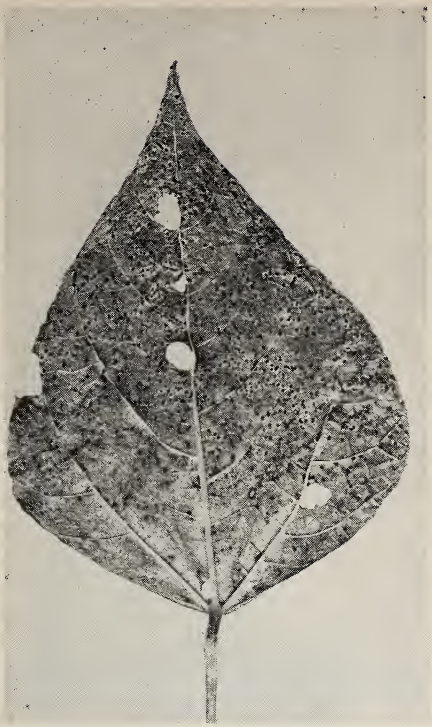

Fig. 4. Bean rust.

Control. Sulphur is specific against rusts in general. Bean rust can be controlled by sulphur, either as a dust, or as wettable sulphur spray. Many rust-resistant varieties of beans exist. However, the development of resistant varieties has not solved the rust problem because the rust is composed of several races that differ in pathogenicity, so that a variety of bean that is resistant in one locality will not be resistant in another locality where a different race of the rust occurs.

Southern Blight or Wilt

(Sclerotium rolfsii)

This, in general, is a minor disease of beans and lima beans, but, because of its striking symptoms, it attracts attention and causes concern. It is characterized by yellowing, wilting, and shedding of the leaves, and sudden wilting and death of the vine. (See under pepper, page 38, for a more detailed description of this disease and its causal fungus).

Stem Anthracnose and Pod Blotch of Lima Bean

(Colletotrichum truncatum)

Symptoms. This disease affects stems, leaves, pods, and seed. On stems it causes elongated cankers. In severe cases, the cankers may girdle the stem and cause death of the plant. In less severe cases, the plant becomes stunted and the leaves show varying degrees of yellowing. Brown lesions develop on the leaves, both petioles and blades. On the leaf blade the lesions occur most commonly along the veins. On the pod, the disease begins as small purplish to reddish blotches. These enlarge and eventually cover the greater part of the pod surface (Fig. 5). In later stages, the color of the blotches changes to tan or brown. Often the fungus may penetrate the pod and infect the seed. Stem anthracnose is primarily a disease of lima beans, although the anthracnose fungus is capable of infecting most varieties of common beans.

Control. It is doubtful that control measures are justified against this disease in Louisiana where lima beans are not grown commercially to any extent. In home gardens the disease normally is of minor importance. In other southern states where limas are grown commercially, the disease, in some years, becomes destruc-

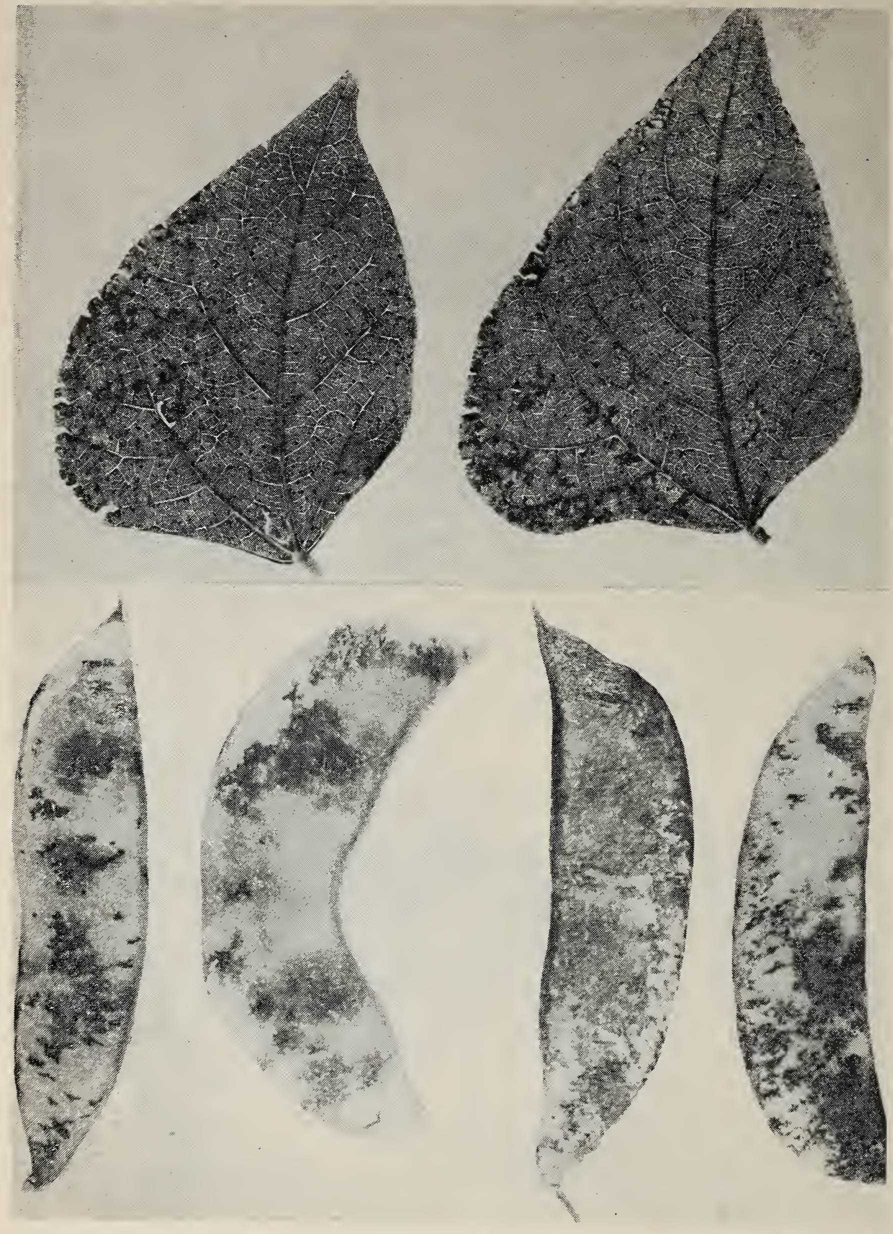

Fig. 5. Anthracnose and pod blotch of Lima bean. Symptoms on leaves and pods.

tive enough to require control. Spray tests in North Carolina showed that several organic fungicides (Ferbam, Ziram, Zineb, Phygon) were effective in controlling this disease.

Pod Blight

(Diaporthe phaseolorum)

This disease, limited to lima beans, is striking in appearance, but is of minor importance. It is characterized by spots on leaves and pods (Fig. 6). On the leaves the spots are large, circular and brown in color. On the pods the spots, which usually do not appear until the pod is nearing maturity, are at first more or less circular with definite margins but, as the pod matures, the infection covers the entire surface of the pod. Numerous raised black specks, the fruiting structures of the fungus, cover the affected area.

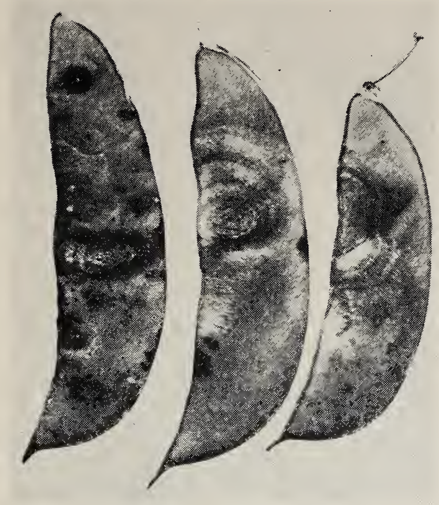

Fig. 6. Diaporthe pod blight of Lima bean.

No control is necessary or justified since the disease does not cause much damage.

Mosaic

(Virus)

There are several virus diseases of bean and lima bean. The ones most common in Louisiana are the common bean mosaic, the Southern bean mosaic, and the lima bean mosaic. The last-named one is caused by a strain of the cucumber mosaic virus. The first two are transmitted through the

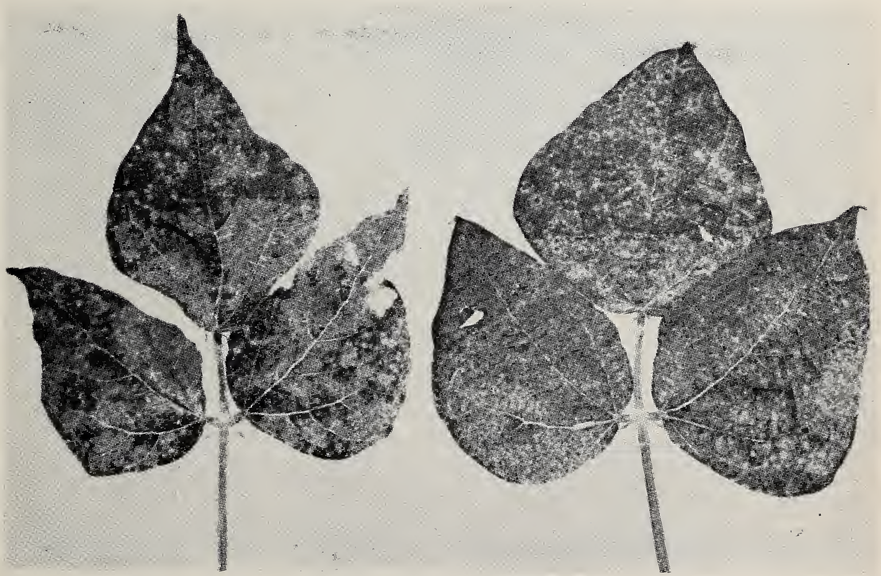

Fig. 7. Bean mosaic.

seed. All are transmitted by insects, particularly aphids. It is not easy to tell what particular mosaic is involved by examining the plants in the field as all cause somewhat similar symptoms. Leaves become mottled (irregular yellow areas on the green leaf), puckered and deformed (Fig. 7). The whole plant is somewhat stunted and of a sickly yellow appearance. Some plants are killed. If the infection starts when the plant is young, few pods are formed, and those that form are of inferior grade. On some varieties (Black Valentine and Tendergreen in particular) the Southern mosaic causes water-soaked irregular spots on the pods. This type of injury has been termed "water wave" by inspectors, and beans so affected fail to make U.S. No. 1 grade.

Control. Since the mosaic viruses are systemic, that is, they are carried in the sap of the plant, there is no cure for the disease once the plant has become infected. Some bean varieties are resistant at least to some of these mosaics. In general, mosaic is a relatively minor bean disease in the State.

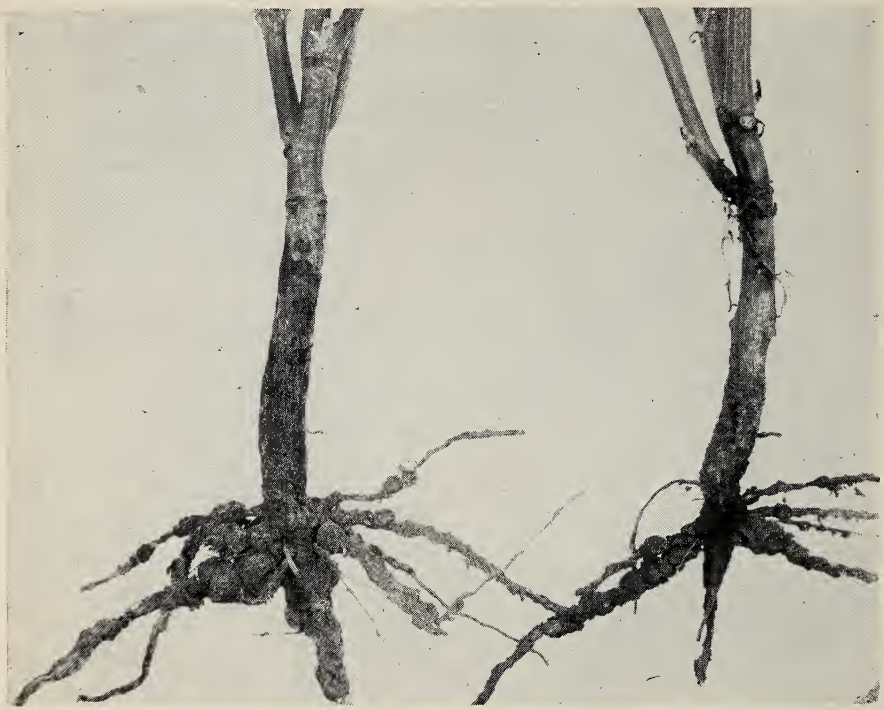

Fig. 8. Nematode root knot on bean.

Root Knot

(*Meloidogyne* spp.)

Both bean and lima bean are very susceptible to root knot nematodes. Nematodes invade the root tissues and cause the formation of galls or knots (Fig. 8). These galls interfere with the absorption of water and minerals by the roots and the plant suffers.

Control. In spite of the fact that beans are very susceptible to root knot, the early-planted spring crop usually escapes serious injury because the soil temperature in the spring is still relatively low and nematodes are not very active under low temperature conditions. In late plantings, and particularly on lima beans and the fall crop of snap beans, considerable injury often occurs. Nematodes are much worse in light sandy soils than in heavy clay soils. It is advisable to avoid, as far as possible, the planting of fall beans in fields known to be heavily infested with nematodes. There are many nematocides available (see soil fumigants, pages 121-127) but in most cases these would be too costly to use.

CARROT

Like the garden beet, carrots are grown only to a limited extent commercially in the State, although they are grown in many home gardens as a winter vegetable. Carrot is subject to many diseases which affect the foliage or the roots or both, but because it is grown during the cool months of the year when most of its parasites are not very active, it usually escapes any serious injury.

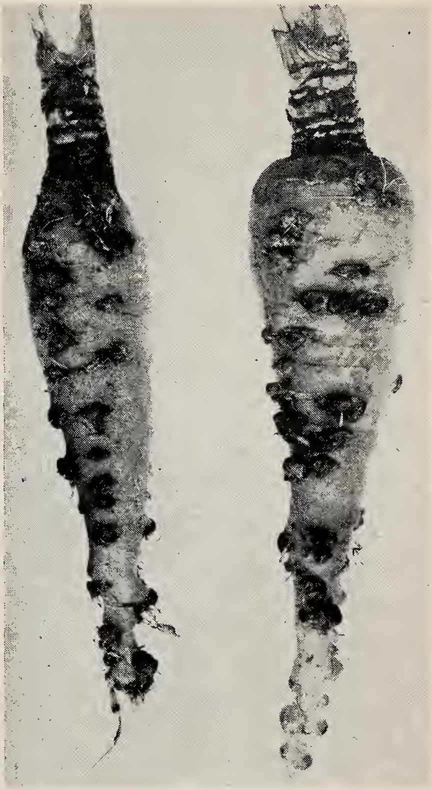

Fig. 9. Nematode galls on carrot.

BEET

Beets are grown as a commercial crop only to a very limited extent in Louisiana, but they are grown in many home gardens as a winter vegetable. In regions where beets are grown extensively in the summer, they are subject to a very large number of diseases. In Louisiana where they are grown only during the cool months, they are relatively free of any serious disease.

Damping-off

Many soil-borne and seed-borne fungi attack the germinating seed and the young seedlings. The young tap roots turn black and rot and the seedlings die. Much of this can be prevented by treating the seed with some fungicide before planting. Several fungicides, such as Cuprocide, Arasan (Thiram), and Phygon (Dichlone) are suitable for this purpose.

Leaf Spot

(Cercospora beticola)

This disease is caused by a fungus parasite which is seed-borne. The spots are small, circular, with brownish to grayish centers and purplish margins. When the spots are very numerous, the leaf turns yellowish and either drops or scorches. The leaf spot fungus is a warm weather organism, and for this reason the disease is of no importance during the winter months. It usually occurs only in the fall on early planted beets or in late spring on late planted ones. It does not cause enough damage to justify control measures.

Root Knot

(Meloidogyne sp.)

Beet is very susceptible to root knot nematodes which cause numerous galls or knots on the roots. However, because nematodes are not very active during the winter months, very little damage to beets results from this pest, except during fall and late spring.

CRUCIFERS

(Cabbage, Cauliflower, Broccoli, Brussels Sprouts, Turnip, Rutabaga, Chinese Cabbage, Mustard)

These plants of the crucifer family are all affected more or less by the same diseases, so they are all treated here as a group. Where differences occur, they are indicated.

Damping-off

(Caused by several soil fungi)

Description. The term "damping-off" has been used to designate a disease of seedlings of many different plants, in the plant bed or in the field, which causes the seedlings to rot at the soil line and collapse suddenly.

The soil contains various fungi which are capable of causing damping-off of seedlings of many different plants. Damping-off damage is of two kinds. Germination may be considerably reduced by the rotting of the seed or of the young seedlings while still under ground (pre-emergence damping-off) ; or the seedlings may be killed after germination (post-emergence damping-off).

Control. Damping-off can be prevented to a large extent by treating the seed with some fungicide before planting. Arasan (Thiram) 75, at the rate of about one tablespoonful per pound of seed, is recommended for seed of cabbage, cauliflower, broccoli, rutabaga, turnip, kohlrabi, and other crucifers. Place the seed in a closed container, add the fungicide, shake until the seed is well coated, then screen off any excess dust.

Black Rot

(Xanthomonas campestris)

Description. This is one of the most destructive diseases of crucifers. The organism causing the disease is seed-borne and may affect the plant at any stage of its growth, from seedling to maturity, in the seedbed or in the field. Symptoms vary with the age of the plant. However, one symptom is nearly always present, and that is the blackening of the leaf veins and vascular bundles of the affected leaves and stems (Fig. 10). Affected leaves usually turn yellow and drop off. Secondary organisms (soft rot bacteria) often invade affected tissues, causing a soft rot with a very offensive odor.

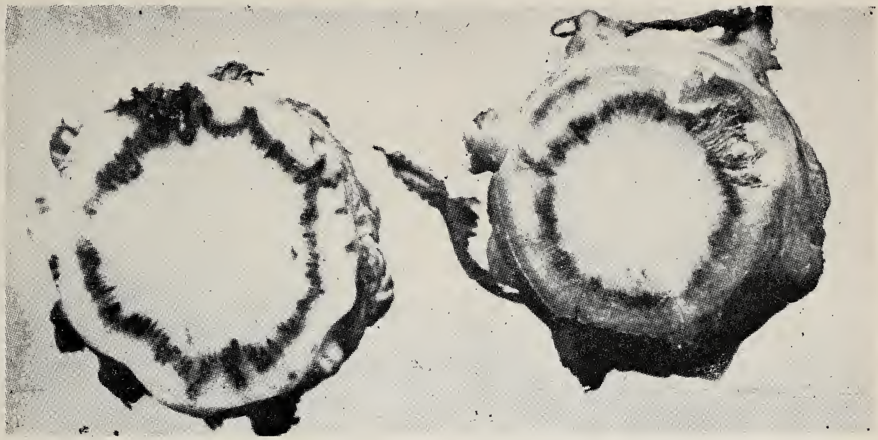

Fig. 10. Black rot of cabbage. Section of stem showing blackening of vascular tissues.

Control. The bacteria causing black rot are carried both on and inside the seed. Those that are borne on the outside of the seed can be easily killed by treating the seed with a bactericidal solution such as mercury bichloride (see page 117). This treatment is not enough to insure control, because the bacteria that are borne inside the seed will initiate the infection in the seedbed, and, if weather conditions are favorable, the disease can spread very rapidly in the field. Since the black rot bacteria do not survive the summer in the soil in Louisiana, the only source of infection is the seed. Therefore, if the seed is treated by the hot water method (see page 120) complete prevention of black rot is obtained.

Seed produced in regions of little or no summer rainfall (such as in California and some other Pacific Coast areas) is free of black rot infection. Such seed need not be treated by the hot water method.

Blackleg

(Phoma lingam)

Description. This disease is

mentioned not so much for its present importance—for in recent years blackleg has rarely been seen in the state—but because it is potentially one of the most destructive diseases of cabbage and allied plants. The disease may affect any part of the plant in the seedbed, in the field, or in storage, but primarily it rots the roots and stems, causing the collapse and death of the plants (Fig. 11). In the seedbed, affected seedlings show whitish sunken dead areas on the stems. Numerous minute specks dot the surface of the killed tissue. These are the fruiting bodies of the organism causing the disease. These bodies produce millions of spores which in turn infect other plants in the seedbed or in the field if conditions are favorable. Infected seedlings usually die soon after transplanting. Older plants in the field may collapse and die at any time.

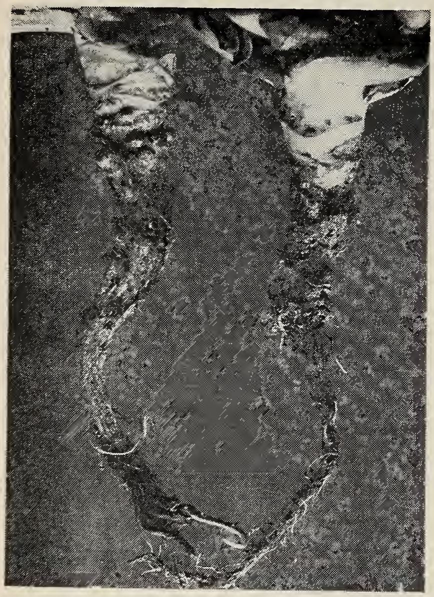

Fig. 11. Cabbage blackleg.

Control. Blackleg is another of the many diseases that are seed-borne. To control blackleg, then, it is necessary either to plant disease-free seed or to treat the seed. Seed produced in the Puget Sound district, where blackleg does not normally occur, is free of infection and requires no treatment for the control of blackleg. If the seed has been grown in a region in which blackleg is known to occur, it is necessary to treat it. The blackleg fungus occurs both on the surface and inside the seed. The corrosive sublimate treatment (see page 117) will kill the fungus on the outside but not on the inside of the seed. Treating the seed with hot water (see page 120) will kill the fungus inside the seed.

Yellows

(Fusarium oxysporum f. *conglutinans)*

Yellows, or wilt, is one of the most important diseases of cabbage in regions where this crop is grown during the summer. Until recently, yellows was unknown in Louisiana and it was thought that perhaps the climatic conditions here did not favor the growth of the fungus. However, the disease was found recently (1955) in destructive form in certain fields in St. Martin and Plaquemines Parishes. It was probably introduced on cabbage seedlings brought in from other states.

Description. The disease affects cabbage plants at any age. The leaves turn sickly yellow. Often one side of the leaf or of the plant turns yellow. The lower leaves become yellow first. The yellowed areas of the leaves soon dry and turn brown. Affected leaves fall prematurely. The plants become stunted. The vascular bundles become brown. The symptoms of yellows resemble somewhat those of black rot, and the two diseases may easily be confused. The leaf veins of plants affected with black rot are black rather than brown. This is the most reliable differentiating feature between the two diseases.

Control. Yellows is controlled by the use of resistant varieties. There are many resistant varieties available, so the cabbage grower has a wide choice of varieties that are resistant and still suitable to his particular region.

Downy Mildew

(Peronospora parasitica)

Downy mildew affects many members of the crucifer family. In Louisiana it is almost exclusively a disease of seedlings in the seedbed, occurring only rarely in the field.

Description. Lesions appear on the leaves, petioles, and stems as small irregular areas, grayish or purplish. Close inspection of the affected areas shows a fluffy white to purplish downy growth, which is made up of sporangiophores and sporangia of the fungus. Later the affected areas enlarge, turn yellow, and finally the leaves dry up and drop off. Under favorable conditions (cool weather and high humidity) the disease progresses very rapidly and may ruin most seedlings in a seedbed in a few days.

Control. Spergon (Chloranil), either as a spray or as a dust, gives satisfactory control if applied early before much damage has been done. Whether as a spray or as a dust, it should be used twice a week during periods of cool, humid weather.

Spray:

Wettable Spergon—2 lbs.
Spreader (any detergent powder such as Tide or Dreft)—4 ozs.
Water—50 gals.

Dust:

Wettable Spergon—6 parts
Clay or talc—94 parts

Watery Soft Rot

(Sclerotinia sclerotiorum)

This disease is not limited to crucifers. The soft rot fungus is an omnivorous pathogen attacking numerous vegetable crops, and also strawberries and some winter ornamental plants such as calendulas. It is a cool weather fungus and it is favored by highly humid conditions. The fungus passes the warm period of the year in a dormant state in the form of black hard bodies, the "sclerotia." In winter and early spring these sclerotia resume growth and give rise to spore cups (apothecia) which in turn produce spores. These spores are blown about by the wind and when they fall on a susceptible plant, they cause infection if the right temperature and humidity prevail.

Description. The cabbage or cauliflower head collapses rather rapidly with a very soft type of rot. At first, the fungus may be seen as a white, cottony growth and this white growth soon gives rise to the hard black sclerotia. These fall to the ground and mix with the soil, there to remain in a dormant state until next season.

Control. Control of this disease is difficult; in fact, there is no satisfactory control. Rotation does not help much since the fungus attacks many other vegetables. Removal of the affected plants from the field before the sclerotia fall to the ground helps. Normally, however, the disease does not become very destructive. It affects individual plants and not the whole field.

Turnip Anthracnose

(Colletotrichum higginsianum)

This is primarily a disease of turnip, although it affects other crucifers including mustard, rutabaga, radish, and Chinese cabbage.

Description. Numerous, mostly circular, spots appear on the leaves, first water-soaked and later drying-up and becoming brown. The dead tissue in the center of the spot often falls out, producing a shot-hole effect. Elongated gray or brown spots also appear on the midrib and petiole. The fungus is seed-borne and the initial infection starts from the few infected seed.

Control. The anthracnose fungus is a warm weather organism. Therefore, the disease normally does not affect turnips or mustard planted in the cool season. Growers often try to rush the season by planting early—in late August or early September—in order to cash in on the early market for turnip and mustard greens.

Wettable Spergon, 4 pounds in 100 gallons of water, has been reported from North Carolina as giving satisfactory control.

Whiptail, Blind Plant

(Molybdenum Deficiency)

Physiogenic diseases due to deficiencies of one or more of the so-called "minor" elements, copper, zinc, boron, manganese, and molybdenum, are common on crucifers on certain types of soils in many parts of the country. Deficiency diseases are rather rare in Louisiana. Molybdenum deficiency, however, occurs in some of the acid soils, particularly in the Florida Parishes, and also in both acid and non-acid soils in Plaquemines and St. Bernard parishes.

Description. Some of the older leaves (especially those of cauliflower) grow narrow and malformed (whiptail); there is considerable crinkling and cupping of the margins of the leaves; the young leaves near the growing point may show bronzing, brittleness, and tip burning; the growing point is often killed, the plant becoming "blind"; cauliflower may not head at all, or may form only small, imperfect heads.

Control. In acid soils, liming gives very satisfactory control. Molybdenum may be present but is unavailable under acid conditions. Liming corrects the acidity and the molybdenum becomes available to the plant. Before planting cauliflower or other crucifers on soil suspected of being acid, have your soil tested. Consult your county agricultural agent on how to get a representative sample of your soil and where to send it to be tested. You will be advised on the degree of acidity and the amount of lime needed to correct it.

Where the trouble occurs on non-acid soils, it means that the element is lacking. In such cases, control may be obtained by using a molybdenum salt as an amendment. Tests at the Plaquemines Parish Agricultural Experiment Substation showed that spraying the plants with a solution of sodium molybdate—½ pound in 100 gallons of water—gave very satisfactory control. A molybdenum salt can probably be mixed with the fertilizer and applied to the soil. In Long Island, New York, where this trouble occurs, it has been corrected by applying either sodium or ammonium molybdate to the soil at rates varying from 1 to 16 pounds per acre.

Different varieties of cauliflower seem to vary in their susceptibility to this deficiency trouble. Snowball A, Super Snowball, and Master are very susceptible; Stella Nova, Snowball X, Snowball Y, and Helios are considerably resistant.

CANTALOUPE, CUCUMBER, SQUASH, WATERMELON

Plants of the cucurbit family are subject to a very large number of diseases. Some of these are of universal occurrence and importance; others are of great economic importance in some regions and relatively unimportant in others. While practically all the diseases that affect cucurbits occur in Louisiana, only the ones that are of economic importance are included in this bulletin.

Downy Mildew

(Pseudoperonospora cubensis)

Although downy mildew affects practically all cucurbits, in Louisiana it is primarily a disease of cucumbers and cantaloupes. Cantaloupes are grown commercially to a limited extent only, mostly in Plaquemines and Lafourche parishes. A small acreage of spring crop of cucumbers is planted in St. Bernard, Plaquemines and Tangipahoa parishes. A larger acreage — about 2000 acres — is planted to fall cucumbers, mostly in Tangipahoa Parish. The spring crop of cucumbers in Tangipahoa Parish either escapes infection completely, or becomes infected late in the season when the crop is nearly over and the resulting damage is small. Fall cucumbers, on the other hand, become infected almost as soon as the plants come up. The reason for the difference between spring and fall crops is that the mildew fungus does not survive the winter in this area. It passes the winter in the frost-free southern part of Florida, and, as the weather warms up in the spring, it spreads northward gradually, reaching the Hammond area of Louisiana about the last part of June. This explanation does not seem to hold true for Plaquemines Parish, because the mildew appears in this area on cucumbers and cantaloupes usually about the first of April, about two months before it appears in the Hammond area.

Description. The leaves become covered with numerous yellowish spots, usually angular in shape (Fig. 12). Later the whole leaf dries and shrivels. The older leaves are killed first so there is a progressive defoliation from the base of the vine toward the tip.

Mildewed vines produce very little fruit of marketable grade.

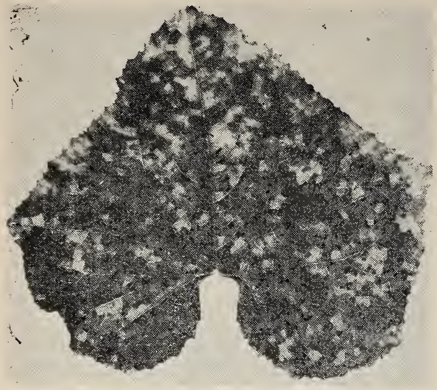

Fig. 12. Downy mildew of cucumber. Early stage, showing numerous, angular, yellow spots on the leaf.

Control. Copper fungicides, such as Bordeaux mixture, are very toxic to the downy mildew fungus but, unfortunately, they are also toxic to cucurbits, causing burning of the foliage, stunting of growth, and reduction in yields. Furthermore, copper fungicides are not very effective against another disease, anthracnose, which usually occurs at the same time as mildew and, under humid conditions, is often more destructive than the mildew. Some of the organic fungicides, Zineb (Z-78 or Parzate), Maneb (Manzate), although somewhat less effective than the copper fungicides against downy mildew, are nevertheless more satisfactory than the copper fungicides because they cause little or no injury to the vines.

The recommended material for control of downy mildew, anthracnose, and insect pests (aphids, beetles, worms) of cucumbers and cantaloupes is a dust of the following composition:

Fungicide*—8 lbs.
Cryolite—20 lbs.
Black Leaf 10 (Nicotine)—10 lbs. or
Black Leaf Dry Concentrate (Nicotine) 7 lbs.
Diluent (talc, pyrophyllite, or clay)—62 lbs. if Black Leaf 10 is used or 65 lbs. if Black Leaf Dry Concentrate is used.

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* Either Zineb (Z-78 or Parzate), Ferbam (Fermate), or Maneb (Manzate).

The dust should be applied twice a week. New growth should be kept covered with the dust. As anthracnose may attack and damage young plants, start dusting when the plants are small. Thorough applications are necessary. Apply the dust when there is little or no wind, either early in the morning or late in the afternoon. The percentages of insecticides (cryolite and nicotine) in the dust formulation are sufficient for insect control if the dusting is done twice a week. However, if aphid infestation becomes heavy, the content of nicotine should be increased.

There is hope that satisfactory control of downy mildew will eventually be attained by means of resistant varieties. The Palmetto variety of cucumber, while not immune, shows considerable resistance. This variety is grown to some extent commercially in other southern states, but it has not done well in Louisiana.

Anthracnose

(Colletotrichum lagenarium)

Anthracnose affects many members of the cucurbit family, but it is particularly destructive to cantaloupe, cucumber, gourd, and watermelon.

Description. The disease is characterized by numerous dead spots on the foliage (Fig. 13). On watermelon, the color of the spots is dark brown to black; on cantaloupe and cucumber the color is distinctly brown. The spots are mostly circular in outline and ¼ to ¾ inch in diameter. In older spots the center tissue often falls out. As the older, lower leaves scorch and shrivel, the plant becomes gradually defoliated, and the fruit, exposed to the sun, becomes sunscalded. Spots develop also on stems and fruit.

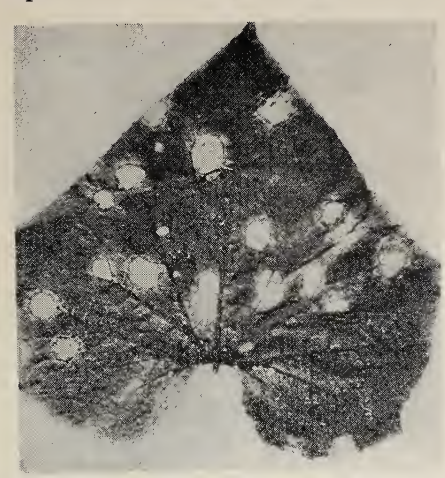
Fig. 13. Cucumber anthracnose spots on leaf.

The symptoms of anthracnose resemble considerably those of downy mildew and the two diseases are often confused. In general, the anthracnose spots are circular to oval in shape, in contrast to the angular spots of downy mildew, and the centers of the anthracnose spots either crack or fall out, whereas those of downy mildew remain intact. From the practical point of view, these differences are not important because the same control measures apply to both diseases and, furthermore, both diseases often occur together.

Control. See under **Downy Mildew,** page 22.

Bacterial Wilt

(Erwinia tracheiphila)

Bacterial wilt is a disease of cantaloupe and cucumber. Squash and pumpkin are only slightly affected and watermelon not at all.

Description. The first noticeable symptom is the wilting of a few leaves or of a single branch of the vine. This is soon followed by the sudden wilting of the entire plant. When the stem is cut and squeezed, a sticky whitish ooze exudes from the cut surfaces. This is a reliable means of telling bacterial wilt from Fusarium wilt, which is discussed next.

Control. Bacterial wilt is caused by a species of bacteria *(Erwinia tracheiphila).* These bacteria, as far as is known, are not seed-borne and do not survive in the soil or in plant refuse. They pass the winter within the bodies of the cucumber beetles and the plants become infected when the beetles feed on them. Therefore, the only effective control for bacterial wilt is to control the beetles. The beetles are easily controlled by dusting the plants with calcium arsenate or with cryolite. In the case of cucumbers which are sprayed or dusted for the control of downy mildew, the arsenical or cryolite is mixed with the spray or dust.

Bacterial Leaf Spot

(Pseudomonas lachrymans)

This bacterial disease is limited

to cucumbers. The first symptoms appear as small water-soaked spots on leaves, stems, and fruit. On leaves, older spots are about ⅛ to ¼ inch in size, somewhat angular in outline, tan on top and gummy and shiny on the under surface. The center of the spots may fall out. On stems, fruits, and leaf petioles the spots are often covered with white, gummy or crusty droplets (tear drops), made up of masses of bacteria that ooze out of the tissue. This is the most reliable diagnostic feature of this disease.

Control. No really satisfactory control is available for this disease. The bacteria are seed-borne, both internally and externally. They do not survive in the soil under Louisiana conditions, so rotation does not help. In the field, the infection starts from the few infected seed in a lot, and then it spreads by wind, splashing rains, and insects. Treating the seed with mercury bichloride (see page 117) helps in that the treatment kills the bacteria borne externally on the seed, but does not eradicate the internal infection. Seed produced in regions of rainless summers (California) is free of infection.

Fusarium Wilt

(Fusarium oxysporum f. *niveum)*

Fusarium wilt, a fungous disease, is limited to watermelon. Squash and pumpkin are not affected. Two different races of the wilt fungus have been reported elsewhere, one causing wilt of muskmelon and the other of cucumber, but neither of these has been found in Louisiana.

Description. The wilt fungus may affect the plant in all stages of its development. It can cause rot of the seedlings underground before they emerge, wilt and damping-off of the seedlings after emergence, and wilt and death of older plants. Wilt shows first at the tips of the runners during the hot part of the day. Wilted vines at first recover during the night, only to wilt again the next day. Wilting becomes progressively more severe and the vine finally dies.

Control. Control of watermelon wilt is a difficult problem. The wilt fungus can live in the soil, and once a field becomes infected it remains so for a long time. Furthermore, the wilt fungus is seed-borne, and in this way it may be spread to new ground if infected seed is planted. Seed-borne infection is not important the first year watermelons are planted on wilt-free soil, because only relatively few seeds will harbor the fungus, but it is important from the point of view of dissemination of the disease to new fields.

A five-year rotation, that is, not planting watermelons in the same field any oftener than once in five years, offers a practical relief against wilt. The wilt fungus is not eliminated from the soil in five years (it is known that it persists in soils 16 years or longer), but it is reduced to the point where watermelons can be grown for one season without much loss from wilt.

The most satisfactory means of controlling wilt is the use of wilt-resistant varieties. Many such varieties exist, and new ones are being developed by breeding. The most important resistant varieties are Klondike (California), Miles (Tennessee), Dixie Queen (Iowa), Charleston Gray (South Carolina), Leesburg, Blacklee, Improved Leesburg, and Brownlee (Florida), and Calhoun Sweet and Summit (Louisiana).

Many difficulties have been encountered in developing resistant varieties. It is easy to obtain wilt resistance by breeding, but very difficult to combine resistance with desirable qualities, such as size, productiveness, taste, flavor, color of flesh, and toughness of rind. Also, a variety may be resistant in one region and not in another. For example, Klondike is very suitable for California conditions and is widely grown there, but is not suited to the South. The same is true for the resistant varieties developed in Iowa. They maintain their resistance in the Mid-West, but not in the South. Because of these difficulties, most of the resistant varieties have not found wide acceptance by the growers in the Southern States. One notable exception is the Charleston Gray. This variety, which possesses many admirable qualities in addition to its wilt resistance, has been accepted by both the growers and the market and is rapidly displacing wilt-susceptible commercial varieties.

The Calhoun Sweet, developed by the North Louisiana Agricultural Experiment Station at Calhoun, is highly resistant to wilt and possesses many excellent qualities—good size, shape, color, taste and flavor, and high yields. Unfortunately, its rind is tender and this limits its use to the local market because it will not stand long distance shipping. Seed of this variety is available.

A second variety, developed by the same station and named Summit, appears extremely promising. It appears to be completely wilt-resistant, has excellent quality, desirable size and shape, tough rind, and produces high yields.

Powdery Mildew

(Erysiphe cichoracearum)

In Louisiana powdery mildew is of some importance only on squash. It is hardly ever seen on cucumber, cantaloupe, or watermelon.

Control. Powdery mildew on squash can be controlled by dusting with sulphur. Sulphur should not be used on cucumber, cantaloupe or watermelon because these plants are sulphur sensitive and severe burning may result. Squash is tolerant to sulphur and can be dusted with sulphur without suffering appreciable injury.

Southern Wilt (Southern Blight)

(See under Pepper, page 38).

Mosaic

(Virus)

Mosaic, which is caused by a virus (see page 5), is one of the most serious diseases of cucumbers in the North, but in Louisiana it is rarely seen on cucumbers. This is probably due to the fact that the insects which spread the virus from diseased to healthy plants are kept well under control in the process of dusting for downy mildew. Mosaic often occurs on squash in Louisiana, probably because this crop is not sprayed so assiduously as cucumbers. Watermelon is resistant to most strains of the mosaic virus and the disease is seldom seen on watermelon in the field.

Symptoms. Symptoms vary with different strains of the virus, but in general the leaves and fruit become mottled and distorted and the entire plant is stunted.

Control. Since mosaic is spread by insects, especially by plant lice, control is obtained by controlling the insects by spraying or dusting.

Root Knot

(*Meloidogyne* sp.)

Cucurbits are among the plants most susceptible to the root knot nematode (see page 4). Plants affected with root knot are stunted in growth, pale green and unthrifty in appearance. When dug and examined, their roots are found to be covered with swellings or knots.

Control. See under TOMATO, page 66.

COWPEA

(Field Pea, Crowder Pea, Blackeye Pea)

Cowpea *(Vigna sinensis)* is primarily a field crop, grown for hay and as a green manure cover crop. In the South, selected horticultural varieties are grown extensively as a summer vegetable. In Louisiana, it is grown for the most part in home gardens but also commercially to a limited extent.

Cowpea is subject to a very large number of diseases caused by bacteria, fungi, nematodes, and viruses. Only three that are common and of considerable importance in Louisiana are treated here. These are, wilt, leaf spot, and stem canker.

Stem Canker

(Rhizoctonia)

(See under Bean, page 9).

Wilt

(Fusarium oxysporum f. *tracheiphilum)*

Description. The fungus invades the plant from the soil through the roots. The plant wilts and dies. The stem tissue under the bark (vascular tissue) becomes brown in color. The brown discoloration of the vascular tissue is a good diagnostic symptom.

Control. Like other fusarial wilts (tomato, cotton, watermelon), cowpea wilt is controlled by the use of wilt-resistant varieties. Many such varieties exist. Two resistant varieties have been developed by the Louisiana Agricultural Experiment Station. These have been released and seed is available through regular seed channels. The first of these, Calhoun Crowder, is highly resistant to wilt and to the leaf spot, but is of relatively poor quality, compared to the better varieties. The second variety, Louisiana Purchase, is a good quality pea, and is highly resistant to wilt and somewhat resistant to leaf spot.

Dixie Lee is another high quality wilt-resistant variety that does well in Louisiana.

Leaf Spot

(*Cercospora* spp.)

A large number of parasitic

fungi (and bacteria) are capable of causing dead spots on the leaves, stems, and pods of cowpea, but the most important ones are species of *Cercospora*. Susceptible varieties may become severely defoliated.

Control. Although many fungicides are effective in controlling leaf spot, it is doubtful that the use of fungicidal sprays will be economically practical. The use of resistant varieties is the most practical means of control. Many varieties show resistance to leaf spot. Varieties that possess resistance both against wilt and leaf spot are the most desirable.

EGGPLANT

Damping-Off

(Caused by several soil fungi)

Eggplant seedlings are very susceptible to damping-off, and to control this trouble it is necessary to treat both the seed and the soil. Treat the seed with Cuprocide (see page 119). As soon as the seedlings begin to emerge from the ground, water the seed bed with a suspension made of 1½ ounces of Cuprocide in one gallon of water. Repeat this once a week.

Blight

(Phomopsis vexans)

Blight is by far the most serious disease of eggplants and in the past, before resistant varieties were developed, it was the limiting factor to the successful growing of eggplants in the state. It affects the plant and its fruit in all stages of development from seedlings to mature fruit.

Symptoms. Brown dead spots form on the leaves. When the spots are numerous the entire leaf is killed. Elongated cankers develop on the main stem and its branches, usually occurring close to the ground. When the cankers girdle the main stem the plant wilts and dies. On the fruit, the disease shows sunken brown spots of various sizes. Sometimes these spots grow very large. Infected fruit usually sheds. The fruit tissue rots underneath the spots. Very numerous dark-colored pimples dot the surface of the cankers on the stem and of the spots on the leaves and fruit. These are the fruiting bodies of the blight fungus. They give rise to millions of spores which are scattered by winds and rains and spread the disease in other plants.

Control. Previous to the development of resistant varieties, no completely satisfactory control for Phomopsis blight was available. The disease is seed-borne, the causal organism occurring both on and inside the seed. The seed treatment recommended above for damping-off control will kill the fungus on, but not inside, the seed. Fungicidal sprays are fairly effective in preventing infection of leaves and stems but not of fruit.

The varieties Florida Market and Florida Beauty are resistant.

Yellows

(Virus)

Yellows is a new disease of the eggplant and is probably caused by a virus (see page 5). The upper leaves turn bright yellow, or sometimes, bleach nearly white. Later the entire plant may become yellow and may finally die.

Control. In Texas, where the yellows disease is sometimes very prevalent in some sections, good control has been obtained by the use of sulphur dust. The plants in the seedbed are kept dusted with sulphur, then one or two additional dustings are given the plants after they are set out in the field. This apparently is a preventive measure. Sulphur evidently kills or repels the insect which transmits the yellows virus from diseased to healthy plants.

Although yellows has been found on eggplants in Louisiana, so far it has not become prevalent enough to be of economic importance.

OKRA

Okra is grown in practically every garden in Louisiana and is usually considered a "fool-proof" crop. However, this plant also is subject to several diseases, some of which may be destructive at times. Of these, wilt and root-knot are the most important.

Wilt

Okra wilt is caused by the same fungus that causes wilt of cotton *(Fusarium oxysporum* f. *vasinfectum)*. It is a typical vascular wilt. First symptoms are yellowing of the lower leaves, followed by gradual wilting and finally death of the plant. The tissue of the stem under the bark shows a dark-brown discoloration.

Root Knot

(Meloidogyne sp.*)*

Okra is very susceptible to the root knot nematode. Galls or knots of varying sizes develop on the roots. The gall tissue rots and the plant dies for lack of a root system.

There is a relation between wilt and root knot, in that wilt is more prevalent and more severe in soils that are infested with the root knot nematodes.

ONION, SHALLOT, GARLIC

Some onion diseases (smut, for example) which are destructive in other parts of the country either do not occur or are of minor economic importance in our state. On the other hand, some diseases that are of no importance in the North are very destructive in Louisiana and in the South in general. The diseases which attack onions and garlic in Louisiana are extremely difficult to control. In fact, diseases constitute the chief factor limiting the development of an extensive onion-growing industry in the State.

Downy Mildew (Blight)

(Peronospora destructor)

Symptoms. Leaves first become pale green, then turn yellow, and finally collapse and shrivel (Fig. 14). Seed stalks are also affected. The plant is not completely killed, but the destruction of the top growth causes the bulbs to be small. Mildew is especially destructive to onions used for production of seed, as mildewed stalks usually fall over before the seed is mature.

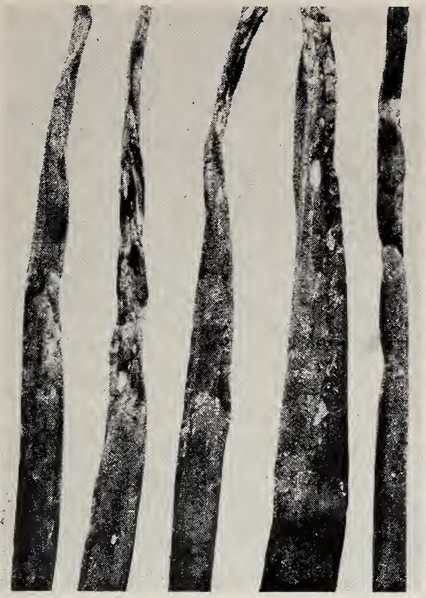

Fig. 14. Downy mildew on onion leaves.

Cause. The disease is caused by a fungus *(Peronospora destructor)*. The fungus carries over from season to season in many ways; in the seed, in the bulbs, and in the soil. Development and spread of the fungus are favored by cool, humid weather.

Control. Control of mildew is extremely difficult. Since the fungus can survive from one season to the next in so many different ways control or eradication by sanitary measures is practically impossible. Spraying has been tried in the past, both in Louisiana and in other onion-growing states, but it has not proved very satisfactory. To obtain good control it is necessary to keep the new growth covered with spray material as soon as it develops. This means spraying at least once a week for several months. Obviously such a procedure is economically impractical.

The ultimate control of downy mildew will undoubtedly be accomplished by developing resistant varieties. A few such varieties exist but these are not suited to Louisiana. An onion-breeding project now in progress at the Louisiana Agricultural Experiment Station has as one of its chief aims the development of mildew-resistant varieties adaptable to Louisiana conditions.

Purple Blotch and Black Stalk Rot

These two diseases, caused by two distinct species of the same fungus, *Macrosporium (Alternaria) porri* and *Macrosporium parasiticum,* are somewhat similar in their symptoms, and for this reason are treated here together.

Purple blotch affects leaves, seed stalks, and bulbs. The disease starts as small, whitish, somewhat sunken spots on leaves and stalks. These spots soon enlarge and girdle the affected leaf or stalk. A little later, a black growth consisting of masses of fungus spores covers the affected area. If conditions are favorable to the development of the disease, the girdled leaves and stalks topple over. The fungus may also infect the bulb, at or after harvest, penetrating the scales at the neck and causing bulb rot. The blotch fungus is capable of infecting non-injured tissues.

The black stalk rot fungus cannot infect un-injured tissues. However, it enters tissues that have been injured. It normally follows downy mildew, growing on the parts of leaves and stalks that have been weakened and injured by the downy mildew fungus, thus completing the destruction. The affected areas become covered with black masses of spores (Fig. 15). Affected seed stalks topple over.

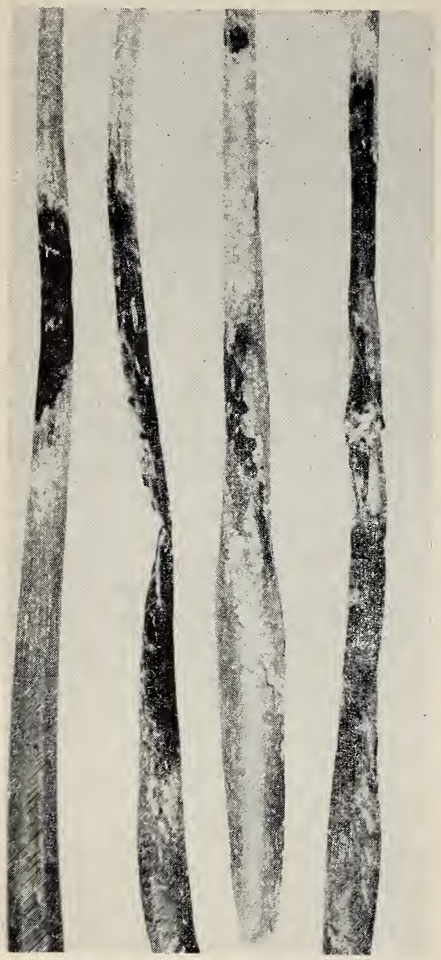

Fig. 15. Black stalk rot of onion.

Control. No satisfactory control is known for either purple blotch or black stalk rot.

White Rot

This disease, which was found in Louisiana for the first time in 1942, is included here not because it is of economic importance at present, but because it is potentially a very serious disease of onions, shallots, and garlic, and should be brought to the attention of growers so as to have them on the lookout for it in case it appears in their fields. In this way it can be caught before it spreads. White rot (caused by the fungus *Sclerotium cepivorum*) is a serious disease of onion and garlic in Europe. In the United States the disease has been found previously in localized areas in Kentucky, Virginia, Oregon, California and New Jersey.

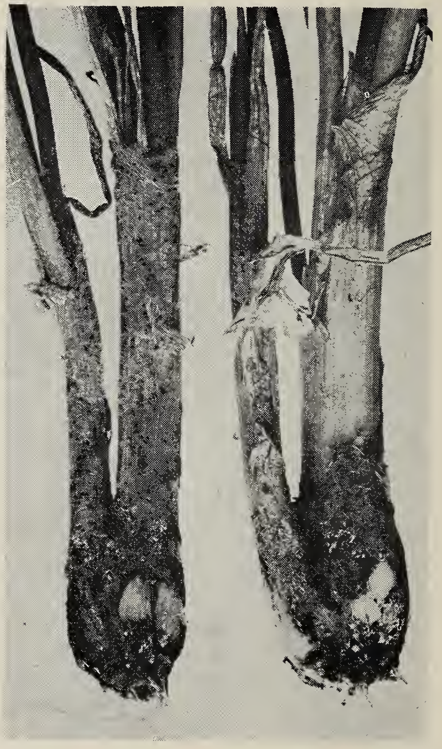

Fig. 16. White rot on shallots.

Symptoms. The roots and the bases of the scales rot. A white fluffy growth (the mycelium of the fungus) and small, spherical, black bodies (sclerotia) occur on the surface of the bulbs (Fig. 16). Affected plants may wilt and die rather suddenly, or may persist in a sickly, unthrifty condition.

Control. Prevention is the only effective control measure for this disease. Once the soil becomes infested, it remains so for many years, because the fungus can survive in the soil even when onions or garlic are not planted. Care, therefore, should be taken to use only healthy sets or transplants. The white rot fungus thrives in cool weather and since onions in Louisiana are grown during the cool months of the year this disease is a potential menace and care should be taken to prevent its spread.

Pink Root

Pink root is another serious disease of shallots, onions, and garlic. The disease is caused by a fungus *(Pyrenochaeta terrestris)* which lives in the soil.

Symptoms. The most charac-

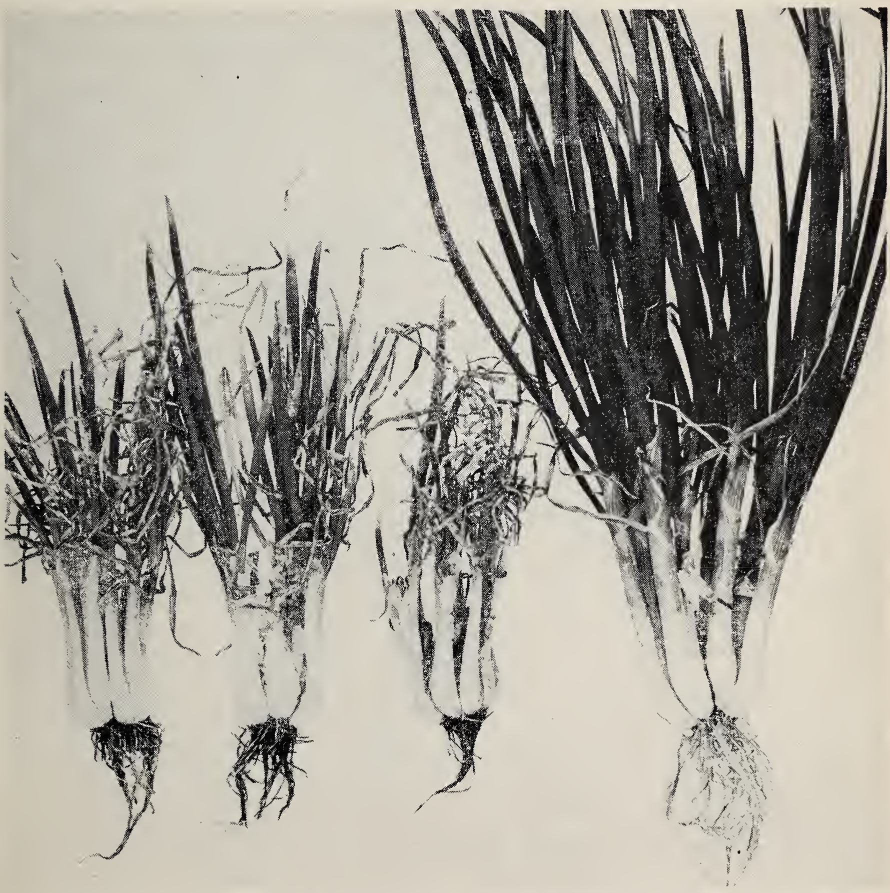

Fig. 17. Pink root on shallots. One healthy and three diseased bunches.

teristic symptom is the pink color of the roots. In addition to the pink color, the affected roots become soft, limp, and finally rot. The plants have an unhealthy, unthrifty appearance, pale green color, more or less stunted growth, and a die-back of the leaf tips (Fig. 17). As these above-ground symptoms may be brought about by other conditions, the only sure way of knowing whether or not plants have the pink root disease is to examine the roots.

Control. Control of pink root is a very difficult problem. Once a field becomes infested, the pink root fungus can survive in the soil for many years, even if no onions or garlic are planted, and rotation, therefore, is of doubtful value as a control measure. Furthermore the fungus is carried over on infected bulbs and sets, and its presence on the dried bulbs and sets is not easy to detect. By the use of diseased sets, the disease is unwittingly spread to new fields. It is possible that varieties resistant to pink root will be developed eventually. Until this has been accomplished the only control measure that may be suggested is prevention. Do not plant onions, shallots, or garlic in fields that are known to be infested. Whenever possible, make sure that the sets you plant have come from disease-free fields. Plant onion seed on new soil or in soil which is not infested with the pink root fungus. This precaution is very important. If the seed is sown in infested soil, the seedlings will become infested and the disease will be spread to areas in which these seedlings are transplanted.

The so-called "summer shallot" varieties, derived from the Japanese Nebuka, possess a high degree of resistance to both pink root and yellow dwarf. They remain green during the summer, and are desirable for the home garden.

Storage Rots

Decay of onions and garlic in storage or in transit is caused by a large number of fungi and bacteria, such as species of *Botrytis* (neck rot), *Fusarium* (dry rot), *Aspergillus* (black mold), *Macrosporium, Colletotrichum* (smudge), bacteria (soft rot), and many others. White onions are more susceptible to storage rots than those with colored skins. Our Creole onion is a good keeper, and shows considerable resistance to many of the storage rots.

Control of Storage Rots. All organisms causing storage rots require moisture for their development. Control of storage rots, therefore, is based on proper curing and storage. Many of the storage rots start in the field, about harvest time, and continue their development in storage. If dry weather prevails during the period of harvesting so as to allow drying and curing, losses from subsequent storage rots will be small. On the other hand, if rains prevail during the period of harvesting and curing, losses from storage rots are to be expected. Curing by the use of artificial heat is very helpful but facilities for artificial curing are not always available.

Yellow Dwarf

(Virus)

Description. Yellow streaks appear on the leaves. In addition to these distinct yellow streaks, affected plants show a general chlorosis. Leaves become twisted and bent. Plants infected in the seedling stage become greatly stunted; those infected later, after they have made considerable growth, are not injured very much. If infected sets, or bulbs, are planted, the injury is much more severe, resulting in dwarfed, malformed plants and reduction in yield of bulbs or seed. Yellow dwarf is primarily a disease of onion and shallot, particularly of the latter in Louisiana. On garlic, the yellow dwarf virus (a particular strain) causes mosaic symptoms. All garlic (the common Italian garlic) plants carry this virus, but it does not appear to cause any appreciable damage.

Control. The yellow dwarf virus is spread in the field by aphids. It is not transmitted through the seed. Therefore, when onions are grown from seed rather than from sets, yellow dwarf is no problem. It is much more of a problem with shallots since shallots are grown from sets. There are shallots that are resistant, but these are not commercially acceptable. A breeding project is in progress designed to develop shallot varieties with acceptable market qualities and at the same time possessing resistance to this and other diseases.

Yellows

(Virus)

This disease is mentioned here not because it is important but because it is so striking in appearance that it is easily noticed in the field and may arouse curiosity or concern. The disease has been seen on shallots and the Creole onion. The leaves of affected plants are so strikingly bright yellow that such plants can be easily noticed from a distance. The plants are stunted in growth and the bulbs are small, soft, and flaccid. If harvested, affected bulbs or sets usually shrivel and dry up in storage. This is fortunate, for the disease is thus self-eliminating.

Yellows is caused by the aster yellows virus which is transmitted by a leafhopper. It affects many different plants, both vegetables (carrot, for example) and ornamentals.

PEA (GARDEN and SWEET)

Damping-Off and Root Rots

Peas, both the edible (English) and those used for their flowers (flowering sweet peas), are attacked by a large number of soil-inhabiting fungi which cause the roots to rot. In this popular bulletin it is considered unnecessary to name and describe the various root-decaying fungi. It is enough to state that at least seven different soil-inhabiting fungi are known to cause root rots in peas.

Root troubles may manifest themselves in different ways: (1) The seed may rot without germinating, or the little seedlings may rot before coming out of the ground (pre-emergence damping-off; (2) the emerged seedlings may be killed gradually; (3) the older plants may show an unthrifty, unhealthy kind of growth, pale green color, stunting, wilting, and gradual dying. If such plants are examined it will be found that their underground parts will show various degrees of decay.

Control. Root rots are difficult to control. Most root-rotting fungi live in the soil; others are seed-borne. Soil and moisture conditions also influence the severity of root rots. No single control measure for root rot can be offered. However, the following measures are suggested as of value for keeping injury from root rots to a minimum:

1. *Seed Treatment.* Treat the seed with Cuprocide (see page 119). This treatment controls preemergence damping-off and insures a good stand.

2. *Source of Seed.* Use Western-grown seed when available. Western-grown seed is not only free of some of the root and foot-rotting organisms, but also of those of bacterial blight and *Ascochyta* blight.

3. *Rotation.* Rotation is very helpful. If enough land is available it is advisable not to plant peas on the same ground any oftener than once in four years.

4. *Resistant Varieties.* The "Creole" pea, which in recent years has been grown extensively in home gardens throughout the State, is relatively resistant to root rots. It is also fairly tolerant to mildew. Unfortunately, the Creole is a rather poor quality pea.

5. *Soil Moisture.* Plant peas only on well-drained ground. Root rots are decidedly more destructive in poorly drained soils.

Ascochyta Blight

Three species of the fungus known as *Ascochyta* are involved in this blight. These cause purplish to tan-brown, irregular to round, often sunken spots on the leaves and pods (Fig. 18, A) and elongated lesions on the stems. When stem lesions occur near the ground a foot rot is produced which kills the plants.

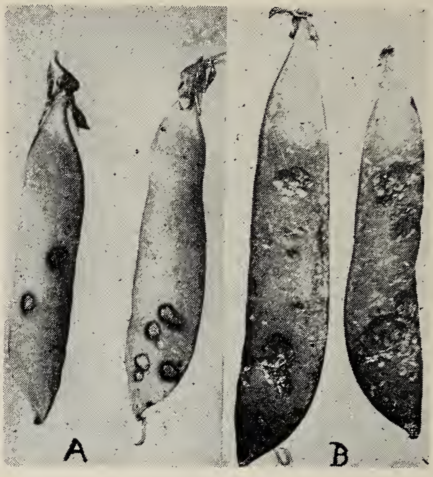

Fig. 18. Pod blights of peas. (A) Ascochyta blight. (B) Bacterial blight.

Control. Since the fungi causing this disease are seed-borne, good control has been obtained by planting blight-free seed on land on which peas were not growing the previous year. That is, control of blight is based on a combination of disease-free seed and rotation. Western-grown seed is usually free of blight. If local seed is used, it should be saved only from healthy plants.

Bacterial Blight

A second blight which very

commonly becomes destructive on peas in Louisiana is that caused by bacteria *(Pseudomonas pisi).*

Symptoms. Numerous water-soaked spots on leaves, stems, and pods (Fig. 18, B). Later the spots turn brown in color. Heavily diseased plants may wilt.

Control. Use blight-free seed. Seed grown in the semi-arid western states is usually blight-free.

Powdery Mildew

(Erysiphe polygoni)

Powdery mildew is easily recognized by the whitish, powdery growth on the upper surface of leaves and stems. After some time affected leaves shrivel and fall off.

Control. Powdery mildew usually occurs late in the season after the crop is nearly over, and it is doubtful that control measures are justifiable. However, powdery mildew can be easily controlled by dusting with sulphur. It is advisable to dust as soon as mildew appears before any damage is done. A second application of sulphur may be necessary if mildew persists.

Anthracnose

Anthracnose, caused by a fungus *(Colletotrichum pisi)*, is of no importance on English peas in Louisiana but it is often very destructive on flowering sweet peas. It causes irregular brown dead spots on leaves and flowers and elongated dead areas on stems and flower stalks.

The disease is favored by cool, moist weather. It often becomes very destructive on sweet peas during April if cool, rainy weather prevails.

No satisfactory control is known for this disease.

PEANUT

Leaf Spot

(Mycosphaerella arachidicola and *M. berkeleyii)*

Description. The most important disease of peanuts is the leaf spot which is caused by two species of the fungus *Mycosphaerella.* The spots on the leaves are brownish to black with light-colored margins and circular to irregular in outline (Fig. 19). On the stems and leaf stalks, the spots are elongated. The disease causes the leaves to shed before the crop is ready to harvest and this premature defoliation results in low yields of both nuts and hay.

Control of leaf spots by the use of fungicidal dusts has become a common practice in the principal peanut producing states. Tests conducted in Louisiana showed that sulphur dusted plots yielded

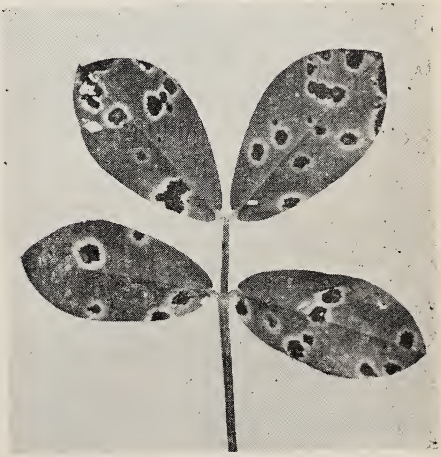

Fig. 19. Leaf spot of peanut.

about 40 per cent more nuts and 32 per cent more hay.

Southern Blight

(Sclerotium rolfsii)

This fungus which attacks many different kinds of plants (see PEPPER, page 38) sometimes causes stem and pod rot.

Control. Rotate. Do not plant peanuts on the same land on which the disease occurred the previous year.

PEPPER

Damping-Off

(Caused by several soil fungi)

Description. See SEED TREATMENT, page 116.

Control. By treating the seed with copper oxide (Cuprocide) better germination and better stand of seedlings are obtained. Add 2 level teaspoonfuls of Cuprocide to each pound of seed in a closed container, shake until the seed is well covered, then screen to remove any surplus dust that has not adhered to the seed.

This treatment is usually sufficient to insure good germination and to prevent damping-off of the seedlings after germination. If the seed has not been treated, or if plants continue to damp off in spite of seed treatment, water the plants with a suspension made with 1¼ ounces of Cuprocide per gallon of water. One watering usually is enough, though a second will not be harmful.

Bacterial Spot

(Xanthomonas vesicatoria)

Description. This disease occurs both in the seedbed and in the field. It forms spots on leaves and fruit. On the leaves, the spots are at first raised and wart-like but soon the tissues dry out, leaving small, dark-brown, more or less angular spots (Fig. 20). Spotted leaves soon turn yellow and shed, resulting in defoliation and stunting of the plant. Severely defoliated plants set very little fruit, and that is usually of unmarketable quality. On the fruit, the spots are raised and wart-like.

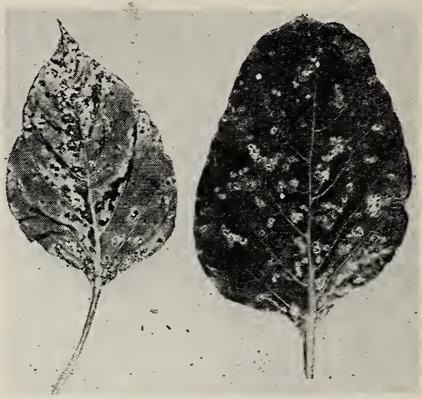

Fig. 20. Bacterial leaf spot of pepper.

Control. The disease is seedborne. The bacteria causing the disease are carried on the seed and they are known to remain viable for at least a year. It is suspected that the bacteria may live over in the old plants in the field, but this has not been proved experimentally. Under cultural practices prevailing in the sweet pepper growing districts of Louisiana, where the plants are plowed under as soon as the crop is harvested in early summer, it is very doubtful that the bacteria survive in the soil from one year to the next. So far as sweet peppers are concerned the control of bacterial spot is best accomplished by disinfecting the seed. Cuprocide, which is recommended for the control of damping off, unfortunately does not control bacterial spot. A more drastic method is necessary.

The Corrosive Sublimate Treatment. Soak the seed in a 1-1000 solution of corrosive sublimate (see SEED TREATMENT, page 117, for directions for making the solution) for five to six minutes, wash thoroughly in running water (or in several changes of water), and either plant directly while still wet or spread out to dry. It is better to dry the seed after this treatment, for then it can be dusted with Cuprocide for the control of damping-off. While the corrosive sublimate treatment is very effective, it is also risky and should be used with care. Pepper seed is sensitive to corrosive sublimate and may be injured somewhat under certain conditions.

Cercospora Leaf Spot (Leaf Drop)

(Cercospora capsici)

Description. This disease is differentiated from the bacterial leaf spot by the large, circular to oblong spots with grayish centers and dark brown margins (Fig. 21). Spotted leaves turn yellow and drop off, hence the common name "leaf drop." The damage is caused by the defoliation of the plant. Spots develop also on the stems of the plant and on the fruit.

The disease appears in the field usually about the middle of May, and if conditions are favorable (hot, wet weather), the plants may become badly defoliated in two or three weeks. The disease apparently is not seed-borne. We have been unable to obtain the fungus from the seed and we have never found the disease in the seedbed, although a careful search for it has been made. On the other hand, we have found the fungus fruiting profusely in the spring on infected pepper stems and leaves which had over-wintered outdoors. So it appears that, under Louisiana conditions, the leaf drop fungus is carried over from one season to the next on infected pepper refuse.

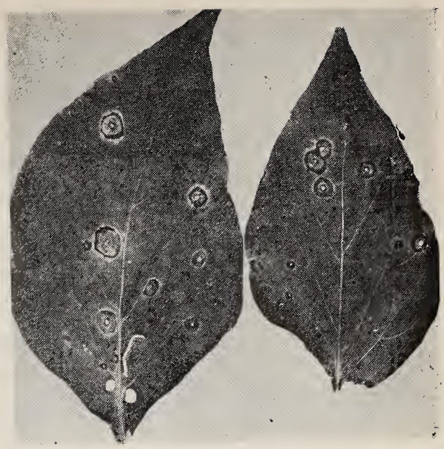
Fig. 21. Cercospora leaf spot of pepper.

Control. The disease can be controlled by spraying with 4-4-50 Bordeaux mixture or with some other copper spray. We have obtained good control by spraying with 4-4-50 Bordeaux and also with some of the "fixed" copper fungicides, such as "Spraycop" and Tribasic Copper Sulphate, 3 pounds in 100 gallons of water.

Even though spraying is effective in controlling this disease, it is still a question whether or not it pays to spray. The disease becomes progressively worse as summer advances. If the harvesting season is long, it will undoubtedly pay to spray, and the length of the harvesting season is conditioned by the market price for peppers. Some years the price of peppers drops by the end of June to the point at which it does not pay to pick. Under these conditions it is questionable whether or not spraying for the control of this disease would be economically practical.

Southern Wilt (Southern Blight)

This disease is caused by a soil-inhabiting fungus known by the technical name of *Sclerotium rolfsii.* The fungus is a warm climate organism and is common in the Southern States. It attacks a very large number of different plants during the hot summer months. The fungus attacks the plant at the ground line, girdling and causing it to wilt and die rather suddenly. The disease is easily recognized by the white web-like growth of the fungus and the numerous creamy-white to brown seed-like bodies (sclerotia) which are found on the girdled part of the stem and on the ground. The sclerotia are about the size, shape, and color of mustard seed. These bodies remain viable in the soil and carry the fungus over from one season to the next.

No control is known for this disease. Fortunately, it is a minor disease. Occasionally it may cause the death of a considerable number of pepper plants in some fields, but in general it is a disease of small importance.

Mosaic

(Virus)

Description. The symptoms of mosaic vary considerably (there are different strains of mosaic) but in general they consist of mottling (green and yellow color) and distortion (puckering, twisting, malformation) of the leaves and general stunting of the entire plant. If the plant becomes infected when young it is entirely worthless; it remains stunted and either sheds its blossoms or, if any fruit is set, it is small and misshapen. If infection occurs after the plant has reached maturity the damage is decidedly less.

Control. Mosaic is highly infectious. It is spread principally by plant lice (aphids), but also by other insects and by handling, such as weeding the seedbed, transplanting, and picking. Some of the mosaic viruses are carried in chewing and smoking tobacco, even in cigarettes. Use of tobacco should be avoided while handling pepper seedlings. Furthermore, many common weeds take the virus and may thus serve as a reservoir. Aphids feeding on weeds can pick the virus and transfer it to peppers in the seedbed or the field. It is advisable, therefore, to remove all weeds from the vicinity of seedbeds. The seedbed should be sprayed or dusted about once a week with some good aphicide, such as nicotine, vapotone, or malathion. The thing to remember is that mosaic is much more destructive if the plant is infected when young; if the plant becomes infected after it has set the first fruit, the injury is decidedly less. Therefore, every effort should be made to prevent infection of the seedlings.

Wilt of Tabasco Pepper
(Virus ?)

A destructive disease, characterized by sudden wilting and dying of the plant, is common in tabasco pepper plantings in Louisiana. The plant, usually when fully grown and bearing flowers and fruit, wilts suddenly as if from drouth and dies (Fig. 22). Affected plants are usually scattered through the planting rather than occurring in spots.

The cause of this disease has escaped detection for many years. It was first noted in New Mexico over 50 years ago, where it was attributed to a soil fungus, *Fusarium annuum,* but the evidence was not particularly convincing. It was studied to some extent in Louisiana and it was decided that it was not caused by a soil-borne fungus, but, beyond this, no conclusive evidence as to its cause was obtained.

The latest information regarding the cause of this disease comes from Alabama where it was shown that it is caused by a severe strain of the tobacco etch virus.

No practical control is known.

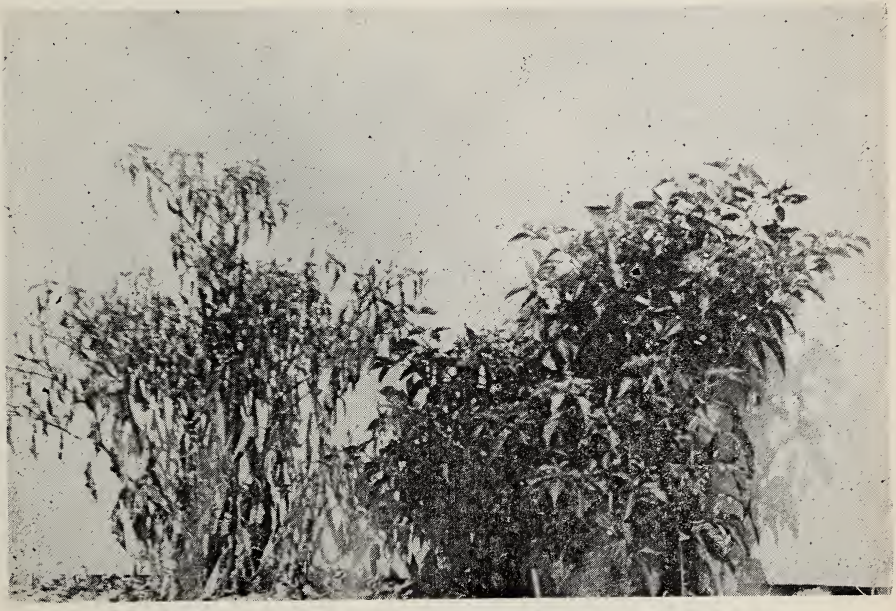

Fig. 22. Wilt of tabasco pepper. Healthy and wilted plants.

IRISH POTATO[2]

The Irish potato is affected by a very large number of diseases. Fortunately, control measures have been worked out for most of these diseases. Furthermore, climatic conditions play an important role in the distribution and severity of some diseases, and so it happens that one of the most serious diseases of the potato——late blight—seldom occurs in Louisiana. Most potato diseases are "seed-borne," that is, they are carried over on or in the tubers. For this reason, the planting of certified seed is the best preventive measure against diseases of the potato. Certified seed, however, is not a "cure-all." Some disease-producing organisms are soil-borne, and others are carried over on other plants which are related to the potato, such as tomato, eggplant, pepper and many weeds. In this bulletin, the potato diseases which commonly occur in the State, or are likely to occur, are briefly described and recommendations for their control or prevention are given.

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[2] For a more detailed account of potato diseases see U.S. Dept. of Agriculture Farmers' Bulletin 2098.

Common Scab

(Streptomyces scabies)

Description. Scab affects only the tubers (Fig. 23). It forms round to irregular, hard, corky areas on the tubers. Scabby spots may be small and solitary or large and fusing together to cover most of the surface of the tuber. The scab organism is both seed- and soil-borne. It likes neutral to alkaline soils. Scab is not a problem in acid soils.

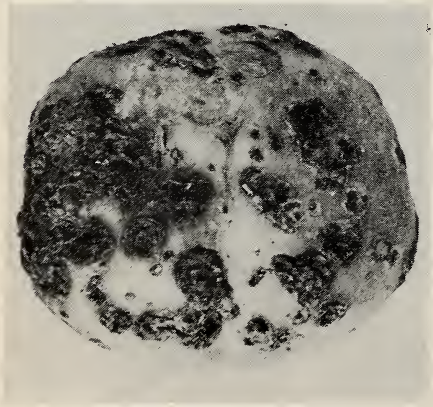

Fig. 23. Scab of potato.

Control. Treat the seed with either of the following disinfectants: (1) Hot formaldehyde (page 120). This method has been in use in Louisiana for several years and has proved its usefulness. (2) Acidified mercuric chloride (page 118).

Black Scurf

(Rhizoctonia solani)

Scurf affects both tubers and stems. On the tubers it forms hard, black bodies (sclerotia) which adhere tightly to the skin (Fig. 24). When the tubers with scurf sclerotia on them are planted, the scurf fungus (Rhizoctonia) grows and attacks the new shoots, forming cankers on the stems and stolons and finally on the new tubers.

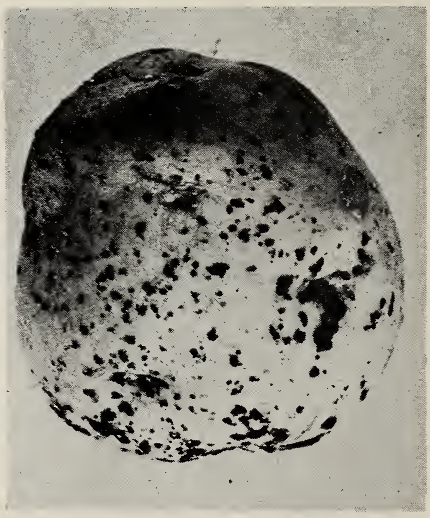

Fig. 24. Scurf of potato.

Control. Same as for "scab" (pages 118, 120).

Since both scab and scurf organisms are common soil inhabitants (they occur even in virgin soils), seed disinfection does not give 100 per cent control, although it helps to reduce the amount of infection to some extent. In view of the rather limited degree of control obtained, many pathologists question the soundness and practicality of treating seed potatoes.

A new chemical, "Terraclor" (Parachloronitrobenzene) has been tried as a soil amendment in various parts of the country and it appears very promising. It shows remarkable effectiveness against both the scab and the black scurf organisms. In California when it was applied to soils very heavily infested with scab, at rates of 150-300 pounds per acre, it gave nearly 100 per cent control of scab.

Brown Rot (Bacterial Wilt)

(Pseudomonas solanacearum)

Symptoms. The first manifestation of the disease is a slight wilting of the plant during the hottest period of the day. The plant recovers at night but wilts again the next day and the wilting becomes progressively worse until the plant dies. At first there is a brown discoloration in the inside of stems and roots (in the vascular bundles), but later the brown color appears externally. The same is true of the tuber. In the early stages the brown discoloration is internal—around the vascular bundles—but later the brown color appears on the outside of the tuber, especially about the eyes. Finally the tubers rot.

Control. Brown rot does not occur in the northern states where potato seed is grown, so the disease cannot be avoided by the use of certified seed; the disease is limited to the Southern States. The bacteria causing brown rot can survive in the soil (particularly in sandy soils) for long periods, and they also attack many other cultivated plants and weeds. This makes it very difficult to try to eliminate the disease from potato-growing land. In Florida where brown rot has been very severe in certain areas, good control has been obtained by applying sulphur to the land in the summer (800 pounds per acre), followed by liming in the fall (3,000 pounds per acre). In Louisiana, brown rot has not been of sufficient economic importance to justify such a drastic and costly method of control.

Ring Rot

(Corynebacterium sepedonicum)

Ring rot also is caused by bacteria (a different species from that causing brown rot). The field symptoms of ring rot and brown rot are similar to the extent that both diseases cause wilting of the plants. They vary, however, in many other respects. Ring rot does not cause a brown discoloration of the stem; brown rot does. Ring rot causes cracking of the tubers and a reddish-brown discoloration of the skin of the tubers; brown rot produces a dark-brown to black discoloration of the tissue of the tuber, with no trace of red color and no cracking.

Control. Unlike brown rot, the ring rot disease is not limited to the South, but occurs in practically all the potato-growing regions of the country. Fortunately, the ring rot bacteria apparently do not survive in the soil from one season to the next. The disease is carried over in slightly infected tubers which do not show external symptoms and may therefore be overlooked by the seed inspector. The bacteria are very infectious and the disease can easily be spread from the few infected tubers by the knife during the process of cutting seed potatoes for planting. In spite of this difficulty, the use of certified seed helps to keep losses from ring rot to a minimum. Seed-producing states are very strict regarding this disease. They will not certify any field that shows even a trace of ring rot, and the only way that the disease can get by is in slightly infected tubers which show no external symptoms and thereby escape detection. Furthermore, Louisiana allows no tolerance for ring rot in certified seed that enters the State. If any trace of ring rot is found in a lot of seed shipped into the State, certification tags are removed, and the lot cannot be sold as certified seed. In this way the grower is protected, to a great extent, against this serious potato disease.

Blackleg and Soft Rot
(Erwinia atroseptica)

Blackleg is a very common bacterial disease of potato, and under certain conditions it may cause severe rotting of tubers both in the field and in storage. The bacteria are carried on the seed pieces if tubers from infected hills have been harvested. The bacteria may also be present in the soil and infect cut seed pieces if these are planted before the cut surfaces have had time to form a protective cork layer. They are also spread by seed-corn maggots.

Description. The first symptoms of blackleg in the field are yellowing and rolling of the upper leaves of one or more shoots in a hill. The plant soon wilts and dies. Inky-black leisons develop on the stem, which may extend several inches above the ground and downward through the stolons into the tubers. Soft rot then develops in the tubers, starting from the stolon end. Affected tubers usually rot very rapidly in the soil. However, some tubers may survive, but these will carry the bacteria and may rot in storage, or, if planted, will carry the infection to the field.

Control. There is no really satisfactory control for blackleg and soft rot. Selection of the seed helps, but it is not easy to detect infected or infested tubers. Cutting the seed several days in advance of planting, thus allowing the cut surfaces to form cork layers is a good preventive measure but not very practical under our climatic conditions. Because of the uncertainty of weather during planting time, the grower cannot cut his seed, let us say, on Wednesday and plan to plant it the following Monday, because heavy rains may make his field unfit for planting for many days. He has to plant whenever weather permits.

Coating the freshly cut seed

pieces with fungicide is a big help. Not enough experimental work on this problem has been done in this state, but work done elsewhere indicates that fungicides are of value in preventing seed piece decay in the soil, particularly when conditions are unfavorable for quick germination. Of the many fungicides tested, Ferbam (Fermate) gave the best control.

Early Blight

(Alternaria solani)

Description. This disease is caused by the same (or closely related) fungus which causes leaf blight of tomatoes (see page 63). It forms brown, dead spots on the leaves. When the spots are numerous they run together and kill large portions of the leaves, thereby causing a reduction in the yield of potatoes. Early blight makes its appearance usually toward the latter part of April. The disease is influenced by weather conditions; wet, warm weather favors its development.

Control. Early blight can be controlled by fungicidal sprays or dusts (see under Late Blight, page 44). It is questionable, however, whether or not it is economically profitable to spray for this disease. The severity of the disease and the price of potatoes in any particular year are the chief factors to be considered. In general, it is not profitable to spray for this disease alone. The small increases in yield in most cases will not compensate for the cost of spraying.

The blight fungus passes the winter on infected plant refuse left in the field. For this reason, it is not a wise practice to plant a spring crop of potatoes in a field in which potatoes or tomatoes were grown the previous fall.

Late Blight

(Phytophthora infestans)

Late blight is by far the most destructive disease of potatoes. It occurs in practically all parts of the world. In this country it is most prevalent in the Northeastern States. It is called "late blight" because in the North it occurs in late summer. In Louisiana the blight first appears, usually about the last week in March or the first week in April. Fortunately, late blight does not occur in Louisiana every year. Its first occurrence in epidemic form was in 1944. Since then it has occurred in 1947, 1948, 1949, 1950, 1952, 1953, and 1957. It occurred in epidemic form severe enough to destroy a large percentage of the potato crop in 1944, 1947, 1948, and 1949. Although the blight does not occur every year in Louisiana, it still constitutes a potential menace to the crop, and the potato grower cannot afford to be caught unprepared; he must keep his spray equipment in readiness.

Description. Blight first appears as pale-green, irregular spots on the leaves. These spots enlarge very rapidly, if moist, cool weather prevails, and soon may kill the entire leaflet (Fig. 25). The tissue of the spots is soft and dark-brown to black in color. A whitish downy growth occurs on the under surface of the blighted tissue. This growth is made up of the fruiting bodies and spores of the blight fungus. The leaf petioles and stems may also be affected, and, under humid, cool conditions, the entire plant may be blackened and killed within a few days.

The tubers in the soil become infected from spores which are washed down by rains. Infected tubers may rot in the soil and also later in storage.

Control. Late blight is effectively controlled by the use of fungicides. Before the advent of organic fungicides, Bordeaux mixture and other copper compounds were universally employed and these are still used to some extent. Copper fungicides, although very effective, caused some injury to potato vines. At present the most widely used fungicides for potatoes are organic compounds, carbamates (Dithanes). These come in liquid or solid forms and are sold under different trade names. The carbamates cause no injury to the vines, and, as a rule higher yields are obtained than when copper fungicides are used.

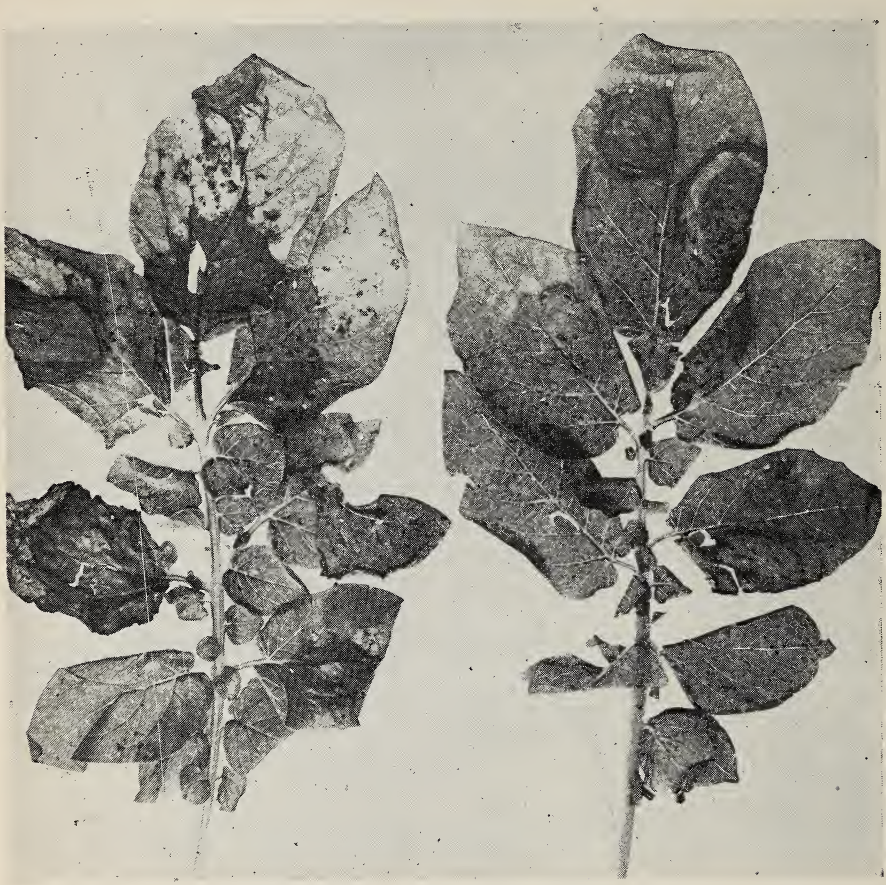

Fig. 25. Late blight of potato.

1. *Liquid Carbamates.* These are made by different manufacturers under different trade

names. The two most common ones are "Dithane D-14" and "Liquid Parzate." Both are of the same chemical composition and are known by the technical name of "Nabam."

To make a spray, use 2 quarts of Nabam and 1 pound of zinc sulfate in 100 gallons of water. Pour the Nabam in the water first, then add the zinc sulfate and stir well.

2. Solid Carbamates. These come in wettable powder form. These, also, are known by different trade names, such as "Z-78" and "Parzate," and by the technical name of "Zineb." These do not require the addition of zinc sulfate. The wettable powder is added to the spray tank (usually at the rate of 3 pounds in 100 gallons of water) and the mixture is ready to use. Solid carbamates are easy to use; all one has to do is add the wettable powder to the tank and go ahead and spray. On the other hand, the liquid forms have the advantage of being somewhat cheaper.

3. Dust. The same materials may be used as a dust. Ten pounds of Zineb (Z-78 or Parzate) are mixed with 90 pounds of a diluent, such as talc or clay. Dusts, in general, are not as effective as sprays. However, if the ground is too wet to allow the use of heavy, tractor-drawn spray machinery, a mule-drawn light-weight duster may be used to save the crop.

Virus Diseases

The potato is subject to a very large number of virus diseases (something like 25 different ones are recognized). All these are not of equal importance. The most important ones in Louisiana are the *mosaics* and *leaf roll.*

Mosaic. There are several of these, differentiated by the type of symptoms they produce on the plant. Two of the most common ones are treated here, namely, "mild mosaic" and "rugose mosaic."

Mild mosaic is characterized by mottling—scattered yellowish areas on the green leaf—and by slight crinkling of the leaves. Affected plants usually droop somewhat and die prematurely. This is a relatively mild disease.

Rugose mosaic is a much more serious disease than mild mosaic. When we speak of mosaic in Louisiana we refer to rugose mosaic. There is mottling of the foliage, as in the case of mild mosaic, but the yellow areas are smaller, more numerous, and close to the veins. The crinkling of the leaves is very pronounced (Fig. 26). Diseased plants are decidedly stunted and die earlier than the healthy ones. Losses from rugose mosaic run very high.

Leaf Roll. The most prominent symptom of leaf roll is the pronounced upward rolling of the leaflets. Other symptoms are stunting of the growth of the plant, stiff, leathery texture of the leaves, yellowish color, reddish or purplish discoloration of some of the leaves, and reduction in yield.

Control of Virus Diseases. Viruses are systemic, that is, they are carried inside the plant. Fungicidal sprays, therefore, are not effective against virus diseases. Furthermore, in the potato, as in other vegetatively propagated

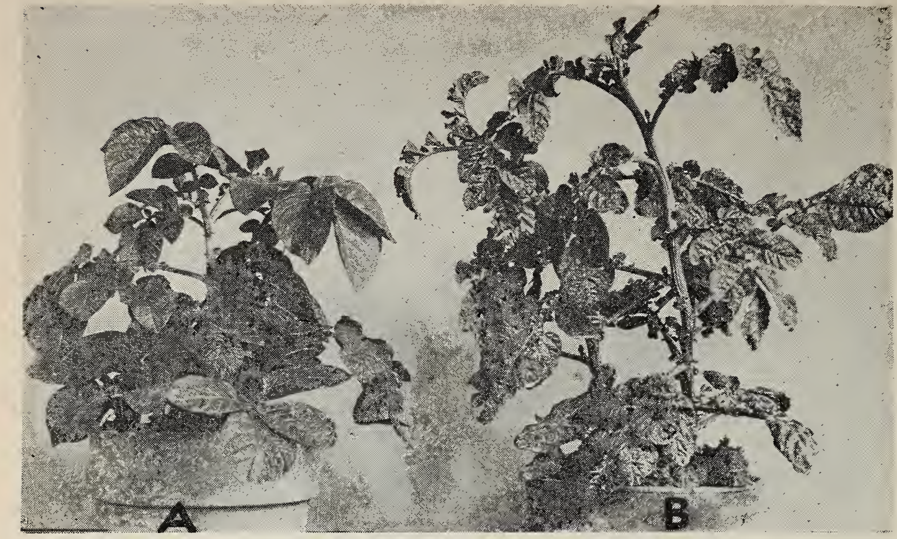

Fig. 26. Rugose mosaic of potato. (A) Healthy plant. (B) Diseased plant.

crops, the viruses are perpetuated in the "seed." All tubers produced by a mosaic-affected vine will contain the mosaic virus and transmit it to their progenies. In nature, viruses are spread from infected to healthy plants by means of insects, particularly aphids. Control of virus diseases of the potato is based on the use of certified seed which is free, or nearly free, of virus. Certified potato seed is produced for the most part in the Northern states where climatic conditions keep the insect populations to a minimum. Seed-producing states have strict regulations in respect to seed certification in order to keep virus and other seed-borne diseases to a minimum. The tolerances permitted by Louisiana for virus diseases in certified seed are 2 per cent for rugose mosaic and leaf roll, respectively, and not over 5 per cent for all viruses combined.

Root Knot
(Meloidogyne sp.*)*

The potato is one of many crop plants that are affected by the root knot (gall) nematodes. Swellings or galls form on the roots and tubers. Infected tubers have a knotty, bumpy surface.

The root knot disease is relatively of minor importance. Losses from it are slight, especially on the spring crop which is grown during the cool season. However, care should be taken not to use infected tubers for seed, for that is a very effective way of spreading the nematodes to new fields.

SPINACH

In the past, spinach has been grown in Louisiana only in isolated patches in home gardens, and under these conditions diseases on this crop have not been a problem. In recent years, however, commercial growing of spinach for canning, quick-freezing and dehydrating has come into use, and the acreage devoted to this crop has been on the increase. Judging by what happens in other spinach-growing regions, and also by past experiences when attempts were made to grow spinach on a large scale in this state, diseases in commercial spinach fields are to be expected. It is for this reason that some of the diseases of this crop are included here.

Damping-Off

(Caused by several soil fungi)

Spinach seed responds very favorably to treatment. Better germination, better stand, and less post-emergence damping-off of seedlings are obtained if the seed is treated. The seed may be treated either with Cuprocide (see page 119), or with Arasan (see page 119).

Downy Mildew

(Peronospora effusa)

Symptoms. Yellowish spots appear on the upper surface of the leaves and a bluish moldy growth on the under surface of the spots. Later the entire leaf may be killed.

Control. This disease is difficult to control. It can be controlled by sprays and dusts, but these leave objectionable residues on the leaves which detract from the market value of the crop. If sprays or dusts are used, applications should stop at least 10 days before harvesting.

The downy mildew is seedborne. In some regions of the country where a single crop of spinach is grown (no early and late planting) excellent control has been obtained by treating the seed with hot water. Although this method has not been tried in Louisiana, it is felt that it should work and it is recommended. Since only one crop of spinach is planted in Louisiana, the only source of infection would be the seed; there would be no spread from an early to a later planting.

Place the seed in a loose bag and immerse it in hot water, 50° C. (=122° F.) for 25 minutes. Remove and plunge in cold water. It is very important to maintain the temperature of the water as nearly constant at 122° F. as possible.

After the hot water treatment, the seed is spread out to dry, and then it can be treated with Cuprocide or Arasan.

Plant breeders are working toward the development of spinach

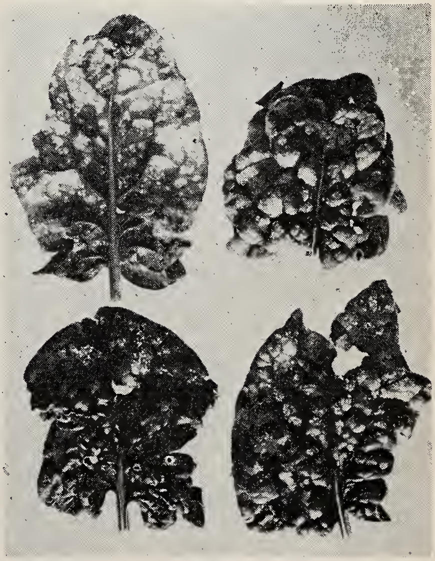

Fig. 27. White rust of spinach.

varieties resistant to downy mildew, and considerable success has already been attained. The California Agricultural Experiment Station has an immune variety, the "Califlay." Whether or not this variety would be suitable for Louisiana conditions is not known.

White Rust

(Albugo occidentalis)

White rust is characterized by white, blister-like spots, mostly on the underside of the leaves and yellow areas surrounding these spots (Fig. 27).

White rust is a very destructive disease in the Winter Haven area of Texas. It appeared for the first time in Louisiana in 1952, destroying completely a planting of several acres in Rapides Parish.

Control. Zineb (Z-78 or Parzate) sprays have been found effective in Texas.

SWEET POTATO[3]

Every year growers and shippers suffer losses from sweet potato diseases. These losses result from reduced yields of marketable potatoes; from spoilage in transit, on the market and in storage; and indirectly from a poor quality product.

Five Most Costly Diseases

Twenty different diseases have been observed on sweet potatoes in Louisiana. Fortunately most of these do not cause much damage to the crop. However, at least five diseases do cause great damage—black rot, stem rot or wilt, soil rot, scurf, and soft rot. These five diseases are caused by five different fungi. The relative importance of these diseases varies from year to year and from locality to locality. In general, however, black rot probably takes the heaviest toll year in and year out.

At least one other disease can be serious in Louisiana—internal cork, which is caused by a virus. Although internal cork has not caused severe losses in Louisiana, it is present in some sections. Investigation and experience indicate that it probably will cause damage in the future.

Minor Diseases

Some of the so-called minor diseases occasionally cause much damage in isolated cases or under certain conditions. These include sclerotial blight, circular spot, surface rot, mottle necrosis, charcoal rot, Java black rot, foot rot, growth cracking, enlarged lenticels, internal breakdown, and root knot nematodes.

White rust and leaf blight, other minor diseases, rarely, if ever, have caused economic loss.

Black Rot

Black rot, caused by the fungus *Ceratostomella fimbriata,* affects principally roots and underground portions of stems. It causes gradual breakdown and a bitter taste. The disease spreads from mother potatoes to slips, which carry it to the field. Infected slips have black lesions on stems or roots (Fig. 28, A). Badly infected slips usually die before

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[3] The section on sweet potato diseases was prepared by Dr. Weston J. Martin.

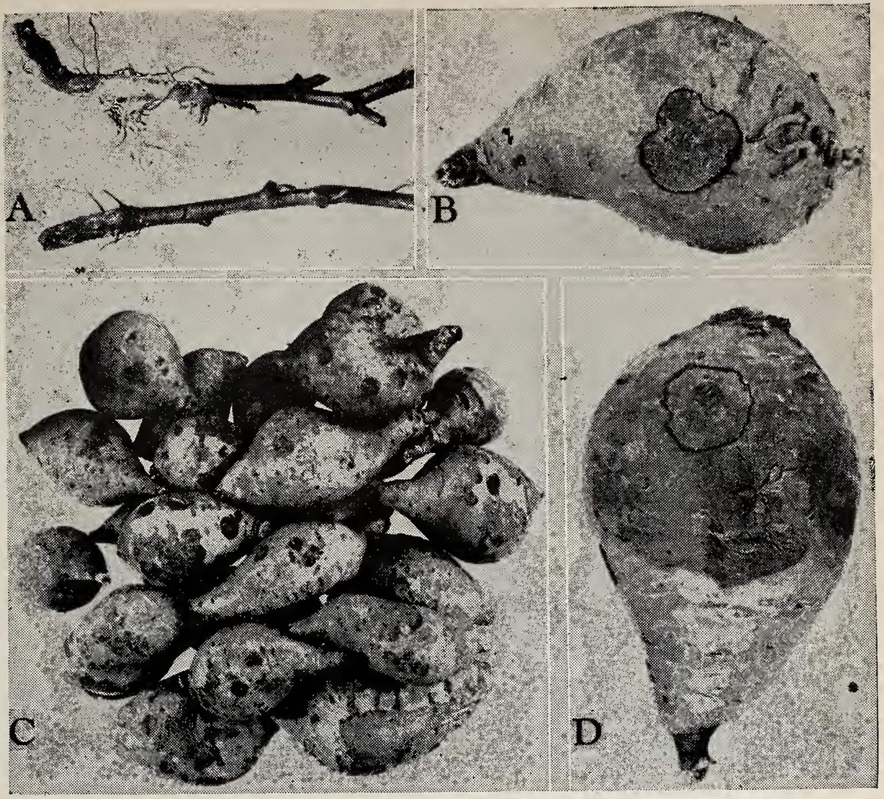

Fig. 28. Black rot of sweet potatoes. (A) Infected slips taken from a seed bed. (B) Infected potato at harvest. (C) Uncured sweet potatoes as they appear 7 to 10 days after washing in a contaminated washing machine. (D) A stored sweet potato that was affected with a small spot of black rot at harvest, showing spread of the rot during storage.

being lifted from the mother potato or shortly after planting. However, slightly infected slips continue to grow and may produce a fair crop. Some potatoes, not necessarily all, from such plants will have black rot lesions (diseased areas) varying from spots too small for the naked eye to see to spots that cover the entire potato. A typical black rot lesion on a potato at harvest is illustrated in Fig. 28, B.

Washing and packing such a potato for shipment before curing will spread millions of spores. The contaminated washing machine will infect other potatoes as they are washed. The disease can then develop on the newly-infected potatoes within the 5 to 12 days in transit or on the market (Fig. 28, C).

If a black-rot-affected sweet potato is stored after harvest, the lesion will enlarge (Fig. 28, D) and eventually destroy the entire potato. Other potatoes that touch the rotting potato can become infected and rot. Entire crates of potatoes can thus be destroyed during storage.

Little effort is made by some growers to control black rot in plantings. It is, therefore, necessary to apply control measures to washed, uncured sweet potatoes, as well as stored potatoes. Control measures follow.

Control of Black Rot in Field Plantings. 1. Select black-rot-free mother potatoes.

2. At bedding time treat mother potatoes as outlined under "General Procedures," page 57.

3. Bed the treated mother potatoes in soil that has not had sweet potatoes in it for at least three years.

4. Use vine cuttings as much as possible in making field plantings.

5. Do not plant in fields that produced black-rot-affected sweet potatoes at any time during the previous two seasons.

Control of Black Rot in Washed, Uncured Sweet Potatoes. For sweet potatoes that are to be washed shortly after harvest and shipped to market:

1. As far as possible wash and package sweet potatoes from crops that have not shown black rot.

2. When a black-rot-affected sweet potato is washed and packed for shipment before curing, it will contaminate the washing machine with millions of spores produced by the fungus. Results of recent research at Louisiana State University have given a very effective method of disinfecting such a contaminated sweet potato washing machine.

a. Directions. Spray the empty machine thoroughly with a two per cent water solution of Vancide 51.* Immediately after spraying, flush out the sprayed parts with water for 3 to 5 minutes before resuming the potato washing operations.

Control of Black Rot in Storage. (See Control of Storage Rots, page 57.)

Stem Rot or Wilt

The disease is caused by the fungus *Fusarium oxysporum* f. *batatas.* It affects the vascular tissues, causing them to turn dark-brown or black. Infected plants usually develop yellow leaves or may wilt and die. The fungus-causing wilt lives in some soils several years and may infect sweet potatoes planted in such soils. It may infect plants in the seedbed also through affected mother potatoes. Thus the disease can be carried to the field.

Severely infected plants usually die. Others, only slightly infected, may grow and produce potatoes. Such potatoes may carry the fungus, more or less dormant, through storage. Infected potatoes used as mother potatoes can infect some of the slips with wilt fungus.

Control of Stem Rot or Wilt. Unit I Porto Rico is very susceptible to stem rot. In heavily infested soils, under some conditions, as much as 50 to 75 per cent of plants of this variety may be killed shortly after planting. Goldrush variety is very resistant to stem rot. So far, Goldrush has not developed much stem rot, even in heavily infested soils. It should be tried wherever sweet potatoes are to be grown in soils known to be infested with stem rot fungus.

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* Vancide 51 is a water solution of the sodium salts of dimethyl dithiocarbamic acid and 2-mercaptobenzothiazole with a total of 30 per cent active ingredients. It is a very effective eradicant of sweet potato rot fungi.

If Unit I Porto Rico is to be planted, follow practices below:

1. Select mother potatoes from fields that have not shown stem rot.

2. Treat mother potatoes as outlined under General Procedures, page 57.

3. Bed mother potatoes in soil that is free from stem rot.

4. Plant in fields that have not produced stem-rot-affected crops of sweet potatoes.

Growers whose soils are free from stem rot should be very careful not to introduce the disease into their fields. They should take every precaution when new seed potatoes are brought on the farm to be sure that the potatoes are free from stem rot. Most farms in the principal sweet potato commercial areas are still free from the disease. Recently, however, stem rot was found in several new locations in the areas.

Soil Rot

Soil rot, caused by the fungus *Streptomyces ipomoea*, affects the roots of sweet potato plants. Smaller roots rot (Fig. 29, A). Typical scabby lesions form on larger roots and on the potatoes (Fig. 29, B). In dry seasons, soil rot occurs most severely, causing stunted plants, which fail to grow and vine out for weeks after planting (Fig. 29, C). The fungus lives in the soil many years. Usually new infestations appear in small, localized spots in the field. Plants in these spots fail to grow and weeds take over. Many stunted plants may die; some may vine out and produce a few poorly-shaped potatoes.

The disease spreads gradually from these localized spots and within a period of years may spread throughout the field. Infestations vary in severity in different fields. In some fields stunting of the plants may not be noticed and yields may be good. But many of the potatoes may be poorly shaped and scabby.

Soil rot is a disease which is very sensitive to weather conditions, particularly to moisture. During wet seasons a fairly good yield may be obtained in a field that produced only stunted plants during a previous dry season. Usually, however, the potatoes produced during a wet season are badly scarred by scabby lesions.

Control of Soil Rot. 1. Select mother potatoes free from soil rot. Take special care to avoid introducing the disease on farms that are free from it.

2. Plant in soils free from soil rot after treating mother potatoes as outlined under "General Procedures," page 57.

3. Make field plantings in soils free from the disease or in soils that have been treated with sulfur, as recommended in Louisiana Agricultural Experiment Station Bulletin No. 408.

4. On the lighter soils with pH values of 5.8 (which includes most of the soils in the commercial sweet potato growing areas), broadcast the sulfur at the rate of 500 to 700 pounds per acre.

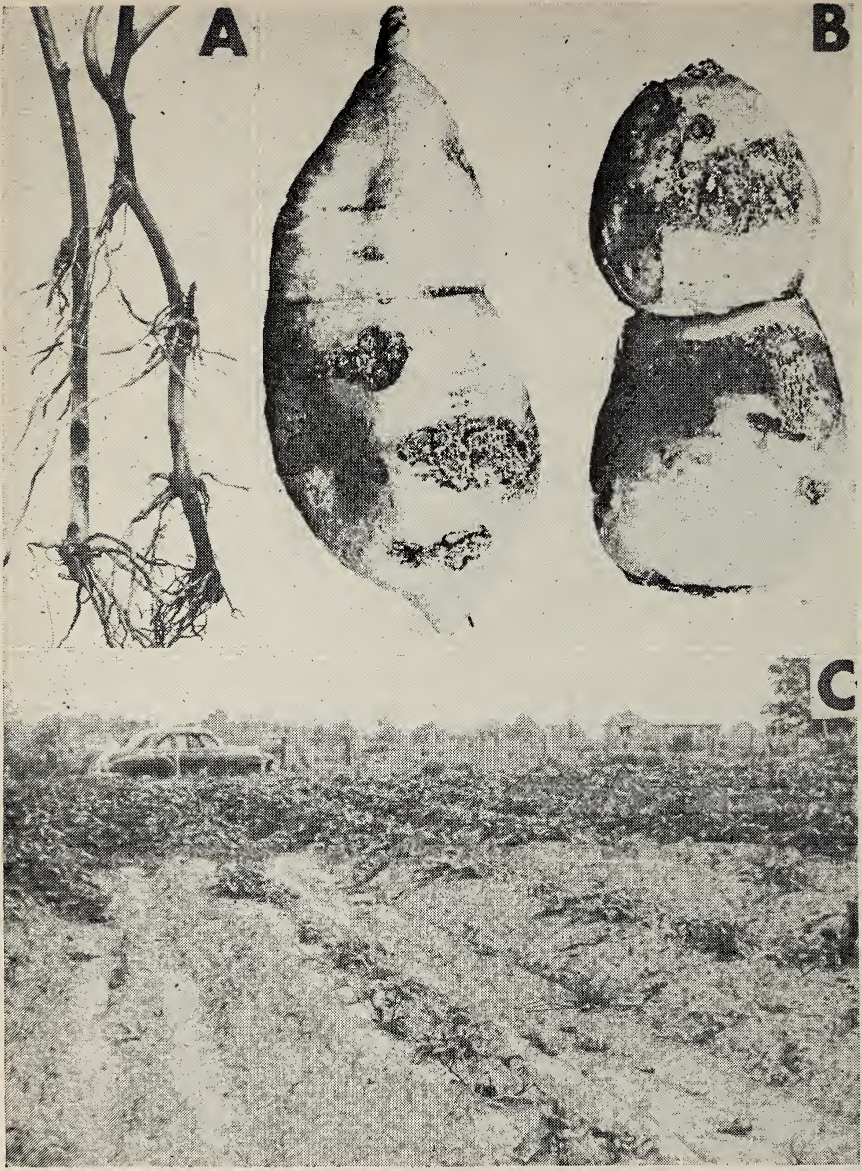

Fig. 29. Soil rot of sweet potatoes. (A) Young plants showing the typical root rot caused by the disease. (B) Sweet potatoes with typical soil rot lesions. (C) A spot of soil rot in a field of sweet potatoes showing the affected, stunted plants in the foreground and the normal vining of less-severely affected plants in the background.

5. Be sure to have a pH determination made of infested soil before applying agricultural soil sulfur. In some poor soils very low in organic matter, as little as 300 pounds of sulfur per acre may

be adequate to reduce the pH to about 5.0. Too much sulfur or uneven spreading of the sulfur in the soil may be harmful, for it may reduce the pH too much for good growth of the potato plants.

Apply sulfur from October to December. Thoroughly disc it into the soil. This allows sufficient time for the action of the sulfur to bring the pH down to about 5.0 (where the causal organism is inactivated) before potatoes are planted the following summer.

Plant only sweet potatoes in the sulfured field the first year after application. After 5 to 6 years it will be necessary to add 200 to 300 pounds of sulfur per acre to the sulfured field, depending on the pH reading of the soil.

6. Heartogold has shown great tolerance to soil rot and has produced moderate yields of fairly good-grade potatoes in infested soils. Goldrush is susceptible to soil rot and has shown typical stunting of plants and rotting of roots in infested soils. However, Goldrush seems to do better than Porto Rico in infested soils.

Besides Heartogold, certain experimental seedlings have done well on infested soils. However, study adaptability and market demands of a particular area before choosing any variety to plant.

Scurf or Soil Stain

Scurf is a sweet potato disease caused by the fungus *Monilochaetes infuscans*. It affects underground parts of the plant, principally the potatoes, causing a dark-brown-to-black stain on the skins (Fig. 30). Scurf spots vary from very small to large ones that cover most of the potato.

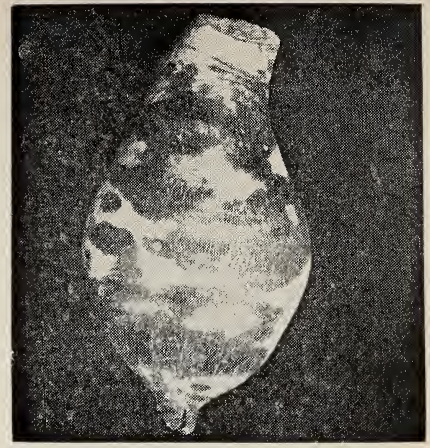

Fig. 30. Sweet potato affected with scurf.

The main damage caused is in appearance and grade of the potato. Potatoes with severe scurf are not U. S. No. 1 grade. The fungus does not penetrate into the flesh of the potato and eating quality is not affected. In storage, scurfy potatoes shrink more rapidly than others.

How Scurf is Spread. Scurf fungus is spread largely through affected mother potatoes. Slips produced by scurfy potatoes may be infected and the disease carried into the field in this manner. The fungus may live in the soil for at least a year.

Scurf may become very severe in some soils under conditions favorable for its development. Some crops of sweet potatoes have been found to be over 50 per cent below U. S. No. 1 grade because of scurf. Usually, however, such severe scurf is traceable to the use of scurfy mother potatoes. Scurf usually develops much more abundantly in soils with high organic matter.

Control of Scurf. 1. Select mother potatoes that are free from scurf. Take every precaution to avoid introduction of the disease on farms known to be free of it.

2. Treat mother potatoes as outlined under "General Procedures," page 57.

3. Bed mother potatoes in soils that have not had sweet potatoes for at least three years.

4. Use vine cuttings as much as possible in making field plantings.

5. Do not plant in soils that produced scurfy potatoes at any time during the previous two seasons.

6. Do not plant sweet potatoes following turning under a heavy cover crop in heavier soils where scurf is commonly present.

Soft Rot

Soft rot is caused by the fungus *Rhizopus nigricans*, commonly called the bread-mold fungus, and other related species. It causes a soft, mushy rot in early stages of the disease. Under humid conditions, the fungus will grow on affected potatoes and appears as a gray-to-black moldy growth (Fig. 31). Eventually affected potatoes become dry and hard. This condition often is referred to as dry rot.

Soft rot fungus infects sound potatoes largely through cuts and bruises made at harvest, during handling for storage, and in packaging for market. Potatoes that have been exposed to a great deal of moisture before harvest often become severely affected. Those that have been exposed to improper storage or transit conditions, especially to chilling, may become badly damaged by soft rot. Losses from soft rot occur principally in storage, during transit of stored potatoes, and on the market.

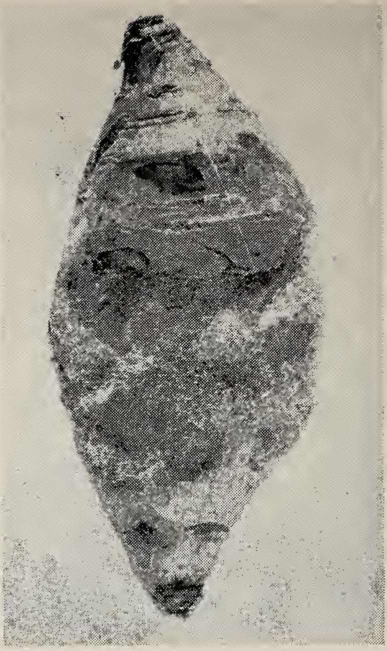

Fig. 31. Sweet potato affected with soft rot.

Control of Soft Rot. Control measures for this disease are similar to those given under "Control of Storage Rots." Be very careful to protect potatoes from chilling and overheating during transit and while they are on the market. Handle them in such a way as to keep bruises down to a minimum.

Recent studies have shown that soft rot develops to a much lesser extent in sweet potatoes washed in washing machines that are disinfected. This is done by spraying the brushes and rollers of the machines with a 2 per cent solution of Vancide 51, as described under "Control of Black Rot in Washed, Uncured Sweet Potatoes." To reduce soft rot development in washed sweet potatoes, disinfect the machinery with Vancide 51 after each 2 to 4 hours of operation.

Internal Cork

Internal cork, caused by a virus, produces brown-to-black corky lesions in the flesh of the potato. A purplish ring-spotting of the leaves seems to be associated in some way with the disease. The spotting appears on older leaves 8 to 12 weeks after planting. Depressions on the surface of affected potatoes occur now and then when there are large corky lesions near the surface of the potato. Lesions in the potato flesh, however, are the only known reliable symptoms of the disease. These diseased areas vary from very small to large ones that may affect most of the flesh of the potato.

At harvest the lesions usually are rather small and may not affect eating quality of the potato very much. In severely affected potatoes, the lesions at harvest may be quite large. However, they increase in number and size during storage. See Fig. 32 for potatoes severely affected after storage. Such potatoes are not edible.

The virus that causes internal cork seems to be carried from diseased potatoes to healthy ones by some unknown insect. The insects feed on the young potato leaves in the seedbed and in the field. Infected plants will produce infected potatoes and infected seed potatoes will produce infected plants.

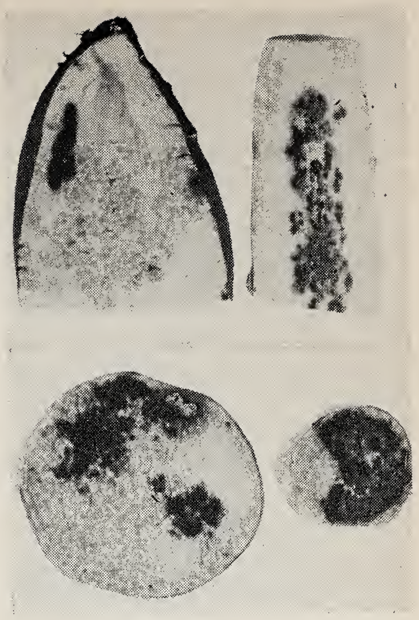

Fig. 32. Sections through sweet potatoes affected with internal cork.

Control of Internal Cork. There is no known method of ridding cork-affected potatoes of the virus. The best known means of fighting the disease is through the use of seed potatoes that are free from it. Since insects are suspected of carrying internal cork, it is very important that growers who have the disease get rid of all their diseased potatoes when they bring in new, cork-free seed stock.

Indications are that the rate of increase of internal cork during storage can be reduced greatly by keeping stored potatoes at 55° to 60° F. Under present sweet potato storage house conditions in Louisiana, it is not possible to maintain temperatures within that range in most cases. However, possibilities of this approach to the internal cork problem should not be overlooked, especially if internal cork increases and spreads as rapidly as studies indicate it may.

Miscellaneous Sweet Potato Diseases

Sclerotial Blight. Sclerotial blight may be quite destructive in seedbeds, particularly during or following very rainy periods. The disease occurs also under field conditions but generally less severely. The causal fungus lives over in the soil. Certain soils appear to be very badly infested. It may be advisable for growers who constantly lose from this disease to bear the expense of fumigating soil used in hotbeds. (See "Seedbed Practices," page 59.) Bed disease-free sweet potatoes after treatment (See "General Procedures," page 57.)

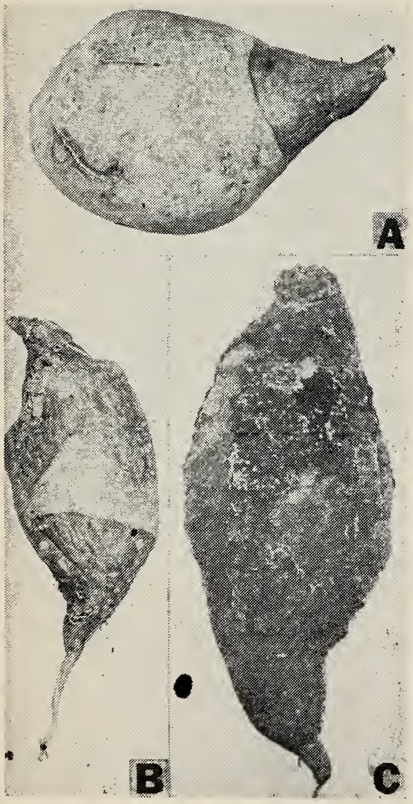

Fig. 33. (A) A sweet potato affected with charcoal rot (caused by Sclerotium bataticola). (B) and (C) Sweet potatoes showing early and late stage of decay from Java black rot (caused by Diplodia tubericola).

Charcoal Rot and Java Black Rot. Charcoal rot and Java black rot (Fig. 33) are principally storage diseases. For their control, use disease-free seed potatoes and practice seed treatment. See also practices outlined under "Control of Storage Rots."

Foot Rot. Foot rot has appeared in Louisiana but it apparently has not caused losses in this state.

Growth Cracks and Enlarged Lenticels. These are sometimes called water blisters (Fig. 34). They are caused by improper moisture relations in the field during the growing season and shortly before harvest.

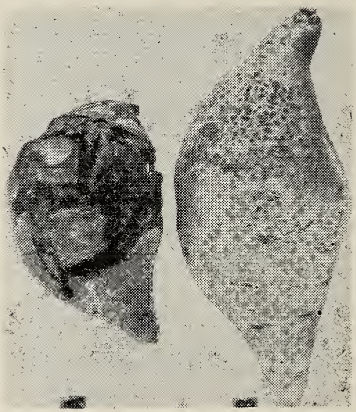

Fig. 34. Growth cracks and enlarged lenticels or "water blisters."

Internal Breakdown. Internal breakdown (Fig. 35) sometimes occurs in stored sweet potatoes.

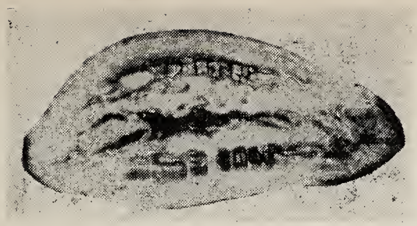

Fig. 35. Section through a sweet potato showing internal breakdown.

It is caused by improper storage conditions and appears to be especially abundant when temperature and humidity fluctuate greatly during storage.

Root Knot Nematodes. Root knot nematodes, present in certain soils, cause some injury to sweet potatoes. However, Unit I Porto Rico ordinarily is not severely damaged, although it may become infected. Certain varieties, such as Allgold, are very susceptible. Other varieties, including Heartogold, appear to be more resistant than Unit I Porto Rico.

Leaf Blight and White Rust. Leaf blight and white rust are fungus diseases commonly found on sweet potato leaves. Some varieties of potatoes appear to be more severely affected by them than the Porto Rico, but so far no evidence of severe damage has been observed as a result of the two.

Control of Storage Rots

Storage rots include soft rot, black rot, Java black rot, charcoal rot, etc. Follow these general practices for control:

1. Apply field control measures outlined for the various diseases.
2. Handle potatoes carefully at harvest and during storage to keep cuts and bruises to a minimum.
3. Thoroughly clean and disinfect storage houses several weeks before storing the new crop, according to directions under "General Procedures."
4. Cure sweet potatoes at 80° to 85° F. and at 85 to 95 per cent relative humidity for 10 to 14 days to allow for proper healing of cuts and bruises.
5. Keep storage temperature as near to 55° to 60° F. as possible (not lower than 50° F.) and the relative humidity at 80 to 85 per cent.

GENERAL PROCEDURES

Selection of Mother Potatoes. Select disease-free mother potatoes. This is very important. There is no known fungicide that will kill black rot and scurf fungi inside affected potatoes without killing the potatoes. Recommended fungicidal dip treatments are effective only in killing spores of these and other fungi present on the surface of the potato; they will not kill fungi inside the potato tissues.

Treatment of Mother Potatoes. Any one of the treatments given below may be used:

1. *Mercuric Chloride Treatment.* This is the old standard treatment for mother sweet potatoes. It has stood the test of many years and all newer treatments have been compared to it. None of the new treatments is more effective in ridding the surface of the potatoes of fungi than this one. (The Semesan Bel or Van-

cide 51 treatment is preferred by some because the time required for dipping is shorter.)

a. Procedure to follow for using mercuric chloride. Dip the potatoes in a 1:1,000 solution for 10 minutes, remove, drain and bed immediately. A 1:1,000 solution of mercuric chloride is made by dissolving 1 part of the chemical in 1,000 parts of water. Use wooden, enamel or earthenware containers, because of the corrosive nature of mercuric chloride. Mercuric chloride is sold at drug stores in tablet form. One tablet dissolved in 1 pint of water makes a 1:1,000 solution. For several bushels of potatoes, it probably is cheaper to buy the chemical in crystalline form.

A handy volume to work with is about 30 gallons, which requires 4 ounces of mercuric chloride. To keep the solution at proper strength, after treating 19 bushels of potatoes add ½ ounce of chemical and enough water to have 30 gallons. After treating about 50 bushels, make an entirely new solution for treating other potatoes.

CAUTION. Mercuric chloride is a deadly poison! Do not eat treated potatoes! Do not feed them to animals!

2. Semesan Bel Treatment. Dip the mother potatoes in a solution made by mixing 1 pound of Semesan Bel with 7½ gallons of water (4 pounds in 30 gallons). Dip the potatoes for 1 minute, drain and bed. Make a new solution when ⅓ of the original volume is lost.

CAUTION: Do not eat potatoes treated with Semesan Bel! Do not feed them to animals!

3. Vancide 51 Treatment. This is a newly developed treatment. Its effectiveness compares very favorably with that of the above two mercurial treatments. It is much less toxic to human beings and animals and has been approved for this use by the U. S. Government authorities.

Carefully remove all defective roots and dip the "seed" sweet potatoes in a 2 per cent water solution of Vancide 51. Keep the roots in the solution long enough to wet them thoroughly. Allow the roots to dry or bed them immediately after dipping. When about ½ of the original solution has been used, discard it. Make a new solution for treating other potatoes.

Cleaning, Disinfecting Storage Houses. Storage rots of sweet potatoes are caused by various fungi, which produce numerous spores. You can get rid of many of these spores. Systematically remove all old sweet potatoes and trash from the storage house. Then disinfect the storage house to destroy remaining spores on the floor, walls, bins, crates, etc. Use one of the following methods:

1. Spray with Copper Sulfate (bluestone). Make a solution by dissolving 2 pounds of copper sulfate in 50 gallons of water. Thoroughly coat all walls, ceiling, floor bins, etc., with the solution. DDT, which is recommended for sweet potato weevil control, may be added. Add 4 pounds of 50% wettable DDT to 50 gallons of copper sulfate solution.

2. Fumigate with Formaldehyde Gas. This method calls for much more work but, if done properly, it should be very effective. It is necessary to keep the storage house airtight.

CAUTION: Formaldehyde is poisonous to human beings. Do not breathe it or let it get in your eyes. Get out of the house quickly after the gas is released.

Procedure to follow for using formaldehyde gas:

a. Determine the number of cubic feet of space in the house to be fumigated. For each 1,000 cubic feet of space, use 3 pints of commercial formalin and 23 ounces of potassium permanganate.

b. Get three or more deep containers (lard cans, garbage cans, open-end drums, etc.), depending on the size of the house. Space them along a line through the center of the house. The containers should be 5-gallon capacity or larger so that the mixture will not run over when the materials are mixed and foaming results. Put the required amount of formaldehyde in the containers. Be careful not to fill containers more than 1/10 full.

c. Weigh out the required amount of potassium permanganate for each container and place it near the container. Do not mix the permanganate with the formaldehyde until later.

d. Close tightly doors, windows and ventilators. Leave open one convenient exit door. Seal cracks and other openings with paper tape to prevent escape of gas.

e. Beginning with the container farthest from the exit door, add permanganate crystals quickly to the formaldehyde. Do the same with other containers. After the crystals have been added to all containers, leave the house very quickly and close the door. As the crystals mix with the formaldehyde, the mixture will foam and gas will come off.

f. Keep the house closed at least 24 hours; then open and ventilate thoroughly for at least 2 weeks before storing potatoes.

CAUTION: Gas generated when adding potassium permanganate to formaldehyde is very irritating to the eyes. Use goggles or a gas mask when working with it.

3. Fumigate with Chloropicrin. Some workers recommend this method. It also requires that the storage house be made airtight and that the house be fumigated for 24 hours, under proper conditions of temperature and humidity, if effective disinfection is to be obtained.

CAUTION: Chloropicrin is a poisonous gas. Closely follow instructions furnished by manufacturers when using it.

Seedbed Practices. Growers who use hotbeds for plant production should take care not to introduce diseases through the soil or mixture used. Where permanent hotbeds are in use, get soil from a source known to be free from sweet potato diseases. Do not use the same soil more than one season without sterilization. Sterilize with steam or chemicals soil that is to be used more than one season in a hotbed. Sterilization by steam requires expensive equipment which may be available in some cases. Sterilization by chemicals (chloropicrin or methyl bromide) may be quite effective, if done according to directions of manufacturers.

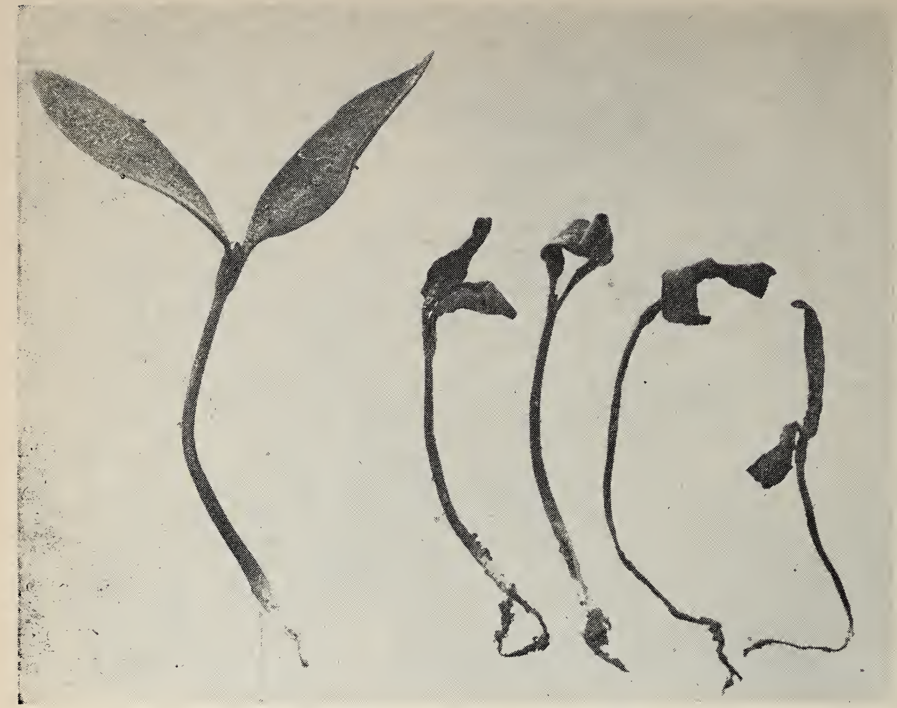

Fig. 36. Damping-off of tomato seedlings.

TOMATO

Damping-Off

(Caused by several soil fungi)

Description. See page 116 and Fig. 36.

Control. Treat the seed with Cuprocide or Arasan (see page 119 for method of seed treatment).

Fusarium Wilt

(Fusarium oxysporum f. *lycopersici).*

Description. This is by far the most serious tomato disease in the southern states. The disease is caused by a soil-inhabiting fungus which penetrates the roots of the plant and grows upward into the vascular bundles of the stem and leaves, causing the plant to wilt and eventually to die (Fig. 37). The lower leaves are the first to show the symptoms. They wilt, turn yellow, and die. The disease progresses upward gradually until the entire plant is killed. Dark brown discoloration of the inside tissue of the stems and leaf stalks is a characteristic symptom.

Control. The most practical way to control this wilt is to grow wilt-resistant varieties. There are many such varieties available. Resistance is relative; it ranges from complete susceptibility to immunity. The geographical region where a particular variety is to be grown also influences the degree of resistance. For example, the varieties Marglobe, Pritchard, and Rutgers, all good and desir-

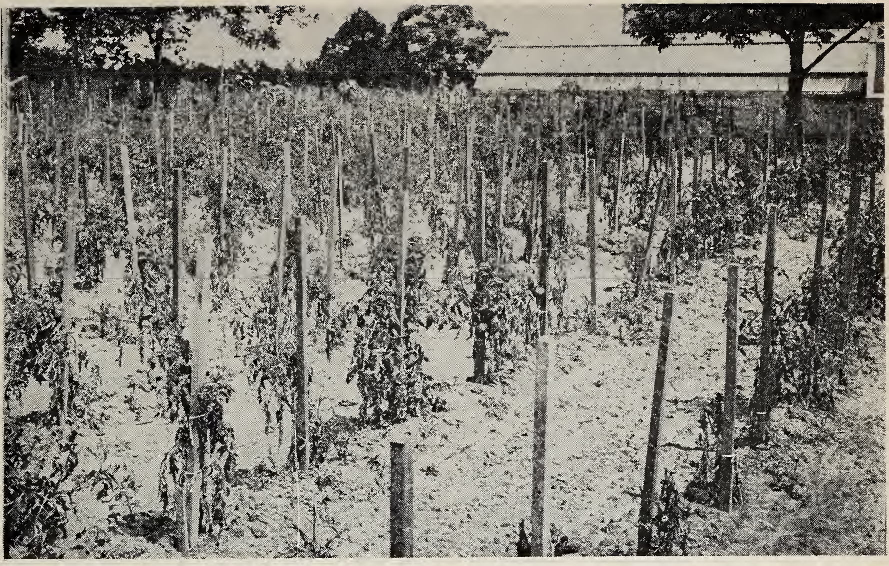

Fig. 37. Tomato field severely infected with Fusarium wilt.

able varieties, exhibit a high degree of resistance in the North but only a slight degree of resistance in the Deep South. The following varieties are very highly resistant under Louisiana conditions: Louisiana Pink, Pan America, Jefferson, Brookston, and a variety, as yet unnamed, developed by the Plant Pathology Department, Louisiana Agricultural Experiment Station. It is expected that this variety will be named and released in the near future. Grothen's Globe, the leading commercial variety in South Louisiana, shows considerable resistance.

It is not enough, of course, for a variety to be merely wilt-resistant. It must possess desirable market qualities to be acceptable for commercial growing. For example, the Jefferson is an excellent variety for home gardens. It is wilt-resistant, of good quality, productive, and bears over a long period. However, it is late-maturing and therefore undesirable for commercial growing.

Control of wilt can also be obtained by soil fumigation. Several chemicals (formaldehyde, chloropicrin, methyl bromide, vapam) are suitable for this purpose. However, soil fumigation is not only costly but difficult in application. (See under "Soil Fumigants," page 121, for more detailed information.

Bacterial Wilt

(Pseudomonas solanacearum)

Description. Bacterial wilt is similar to Fusarium wilt in that the plant wilts and dies. However, there are distinct symptom differences between the two. Bacterial wilt is a sudden wilt. The leaves wilt and the plant dies quickly within a few days after the appearance of the first symptoms, instead of gradually and slowly from the bottom leaves upward as in the case of Fusarium wilt. This quick wilting and dying of the plant is a reliable symptom differentiating bacterial wilt from Fusarium wilt. The inside of the stem and leaf stalks show a brown discoloration similar to that of Fusarium wilt but of lighter shade. The brown discoloration usually extends to the pith of the stem. Bacterial wilt is not limited to tomato; it affects other solanaceous plants: potato, pepper, eggplant, tobacco.

Control. Control of bacterial wilt is very difficult. No resistant varieties of tomato are known. Furthermore, once a soil has become infested, the wilt bacteria persist for many years. Rotation is of little value. No wilt develops in the field if the temperature is 70° F. or lower. However, infection of the seedlings in the seedbed can take place at as low a temperature as 55° F. This fact is important to remember. If infested soil is used in the seedbed, many of the seedlings will become infected but will show no symptoms as long as the temperature is cool (70° F. or lower). It is therefore important to use non-infested soil (or sterilized soil) in the seedbed. This precaution will eliminate one of the principal sources of infection.

Soil fumigation practices may be used (see under Soil Fumigants, pages 121-127).

Early Blight and Nailhead Spot

(Alternaria solani and Alternaria tomato)

There is some disagreement among pathologists as to whether early blight of the tomato leaves and nailhead spot of the tomato fruit are two distinct diseases caused by two closely related fungi, or whether the foliage and fruit symptoms are expressions of one and the same disease, but it is generally accepted that two distinct species of *Alternaria* are involved, *A. solani* causing early blight and *A. tomato* causing nailhead spot. For practical purposes this question is not important, and in this bulletin early blight and nailhead spot will be treated as one disease.

Description. The disease may attack plants at any stage of their development, in the seedbed, cold frame, or field. When seedlings become infected in the seedbed or cold frame, lesions form at the ground line and extend above and

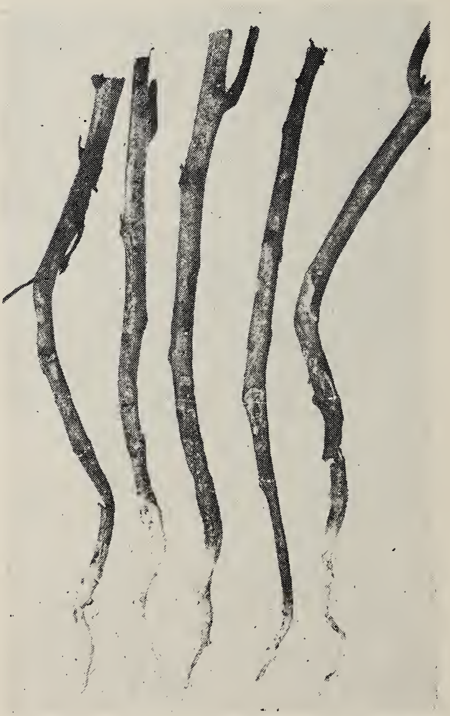

Fig. 38. Alternaria collar rot of tomato seedlings.

below for short distances. These lesions develop into cankers, "collar rot" (Fig. 38). The affected seedlings may be killed, or, if they survive, they usually do not develop into vigorous plants.

In the field early blight appears usually about blossom and fruit-setting time, but may appear earlier or later, depending on weather conditions. The first sign of the disease is the appearance of small brown spots on the lower leaves. These spots enlarge (Fig. 39), and the leaf gradually turns brown, dries up, and dies. The disease progresses upward, the lower leaves being killed first and later the upper ones. In a badly blighted plant all lower leaves are dead and the upper ones are covered with brown spots of different sizes. Spots also often develop on the stems, the fruit peduncles, and the fruit calyces.

On the fruit spots may develop only on the stem end and along cracks and other wounded areas usually as irregular brown to black spots, or be scattered all over the fruit as circular dark brown spots with yellowish margins. The spots may develop on the green or ripe fruit. They begin as shallow tan to gray specks which eventually enlarge. The term "nailhead spot" is used to designate these scattered circular spots on the fruit.

Control. See page 64.

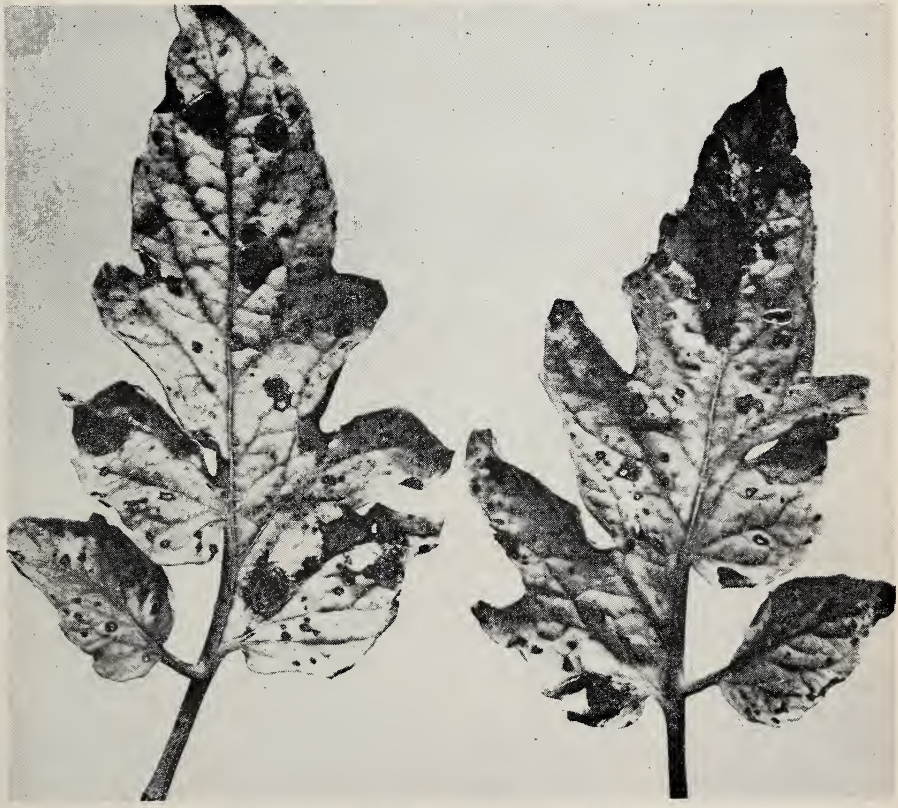

Fig. 39. Tomato leaves spotted by Alternaria blight.

Gray Leaf Spot

(Stemphyllium solani)

Stemphyllium, a fungus closely related to the one causing early blight, has become prevalent on tomatoes, particularly in the southern part of the State, during the past several years. The symptoms (spotting of the foliage) produced by this fungus are similar to those of early blight, and the two diseases are not easily differentiated in the field. For practical purposes, this is not important since the same control measures apply to both.

Control. See below.

Phoma Leaf Spot and Fruit Rot

(Phoma destructiva)

This disease causes small, dark, irregular spots on the leaves and sometimes on stems. Infected leaves turn somewhat yellow and wither prematurely. The fungus also infects the fruit causing rot. In the field the fruit rot phase is not important, but infected fruit may develop rot spots in transit and storage, making it unmarketable.

Control. See below.

Leaf Mold

(Cladosporium fulvum)

Leaf mold is an extremely destructive disease of winter tomatoes grown under glass. As a field disease it is of relatively minor importance. It occurs in Louisiana particularly on fall grown tomatoes.

Description. Large, irregular, yellow areas with indefinite margins appear on the upper surface of the leaves. The lower surfaces of these areas are covered with a velvety, olive-green mold made up of the spores and sporophores of the fungus. Affected leaves drop and the plant becomes progressively defoliated from the bottom upward.

Control. See below.

Late Blight

(Phytophthora infestans)

Late blight is caused by the same fungus that causes the same disease on potato (see page 43). The fungus attacks leaves, stems, and fruit. It can attack the plant at any stage of its growth if favorable weather (cool, humid) prevails. On the foliage and stems the disease first appears as brown to purplish-black lesions. These, under cool humid conditions, enlarge very rapidly, causing severe blight. On the fruit, greenish-gray, water-soaked spots appear, more often on the stem end. These enlarge very rapidly, become dark brown in color, and have a rather firm, wrinkled surface and soft, watery interior.

Control. See below.

Buckeye Rot

(*Phytophthora* spp.)

Buckeye rot of tomato fruit is caused by several species of soil-borne Phytophthoras. These fungi live in the soil and the only way they can get to the fruit is by splashing rains. For this reason, this disease is of minor importance in Louisiana where tomatoes are staked. The rotting of the fruit is similar to that caused by the late blight fungus. However, the buckeye rot Phytophthoras do not attack the foliage.

Control of Fungous Diseases of Foliage and Fruit

Early and late blight, as well

as the other fungous diseases that affect the foliage and fruit of tomatoes, can be controlled by fungicidal sprays. Many different fungicides are effective. Before the advent of organic fungicides, copper fungicides (Bordeaux mixture, tribasic copper sulphate, Cuprocide, copper oxychloride, copper oxychloride sulphate, etc.) were used for this purpose. Copper fungicides are very effective against these diseases, but they, in general, seem to cause some injury to the plant which results in reduced yields. In most tests, plants sprayed with an organic fungicide have given higher yields than those sprayed with a copper fungicide. The following figures, obtained in tests at the Plaquemines Parish Agricultural Experiment Station, illustrate this point:

Yields of Marketable Tomatoes in Pounds Per Acre

Copper A, 4 lbs. in 100 gals.	29,343
Captan, 2 lbs. in 100 gals. water	30,541
Zineb (Dithane Z-78), 2 lbs. in 100 gals.	33,862
Maneb (Manzate), 2 lbs. in 100 gals.	33,154

Because of their better performance, in comparison with the copper compounds, organic fungicides, and particularly the carbamates (Dithane Z-78, Parzate, and Manzate), are preferred for spraying tomatoes and potatoes. Organic fungicides are somewhat more costly than the copper fungicides.

Both the copper and the organic fungicides are compatible with the insecticides that are used to combat tomato insect pests (fruit worms, aphids, red spider), such as cryolite, DDT, malathion, parathion, lindane, rotenone, nicotine, etc. Any of these insecticides may, therefore, be applied with the fungicide as a combination spray instead of separately.

Southern Wilt (Southern Blight)

(Sclerotium rolfsii)

This disease causes the death of an occasional tomato plant in the field, but it is of minor importance. (See under pepper, page 38.)

Blossom-End Rot

(Non-parasitic)

This is a disease of the fruit. For the most part it affects fruit that is about half grown, but it may be found on very young fruit (buttons) or on fruit that is nearly mature. It always affects the blossom-end part of the fruit. The rot starts as a water-soaked spot which enlarges, turns brown in color, and becomes dry, flat, or sunken. Later the killed tissue may be invaded by secondary organisms and become black and hard or soft and watery (Fig. 40).

Blossom-end rot is a physiological disease. It is caused by fluctuation in soil moisture, and particu-

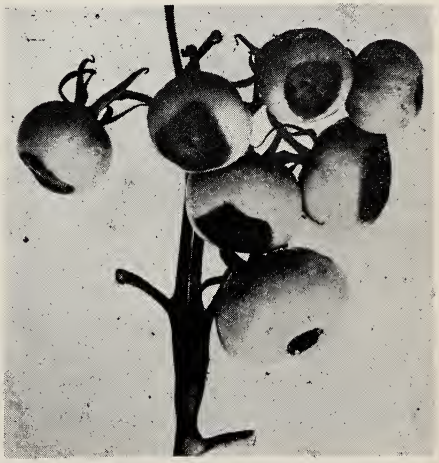

Fig. 40. Blossom-end rot of tomato fruits.

larly when a period of excessive soil moisture is followed by a hot, dry spell, but the reverse situation, a dry period followed by a wet period, can also cause the disease. With susceptible varieties, this is a very serious disease. It may result in 25-50 per cent loss of the crop.

Control. The only satisfactory method of prevention of blossom-end rot is the use of resistant or tolerant varieties. Tomato varieties vary greatly in their susceptibility to this disorder, from highly susceptible to highly resistant. Marglobe and Pritchard are very resistant; Pan America is very susceptible.

Where facilities for irrigation are available, the disease can be prevented by judicious irrigation to prevent sharp fluctuations in soil moisture.

Root Knot

(*Meloidogyne* spp.)

Root knot is a disease familiar enough not to need description. It is caused by a soil-inhabiting microscopic worm (nematode) which invades the root tissues causing them to form the familiar galls or knots (Fig. 8). Nematodes occur almost universally in the soils of regions with mild winters such as those prevailing in the South. They attack a very large number of plants. Among the vegetable crops, tomatoes and cucumbers are very susceptible. Nematodes are especially troublesome in light sandy soils.

No easy control is known for nematodes under normal field conditions. As far as possible tomatoes should not be planted on light sandy soil which is infested with nematodes. This is especially true in the case of the fall crop of tomatoes. The spring crop is planted while the temperature of the soil is still relatively cool and the nematodes are not very active; thus the plants escape heavy nematode infestation in the early stages of their growth. For this reason the damage to the spring crop of tomatoes from root knot is usually not so severe as on the fall crop. If a piece of ground becomes heavily infested with nematodes, partial relief may be obtained by keeping the land clean-cultivated during the warm season of the year, or by planting a root-knot resistant crop such as corn, sorghum, velvet beans, peanuts, or the Iron Clay variety of cowpea for two or three successive years. When such a root-knot resistant crop is planted it is essential to cultivate between the rows to destroy the weeds because many of the weed plants are susceptible to the root-knot nematodes.

Control of root knot can also be obtained by the use of soil fumigants, and although soil fumigation is rather costly, it is a very effective and practical control measure particularly for home gardens. (See under Soil Fumigants, pages 121-127.)

Virus Diseases

Tomato is subject to a very large number of virus diseases. Not all of these occur in Louisiana. The two most important virus diseases of tomato in Louisiana are the *mosaic,* and a disease of recent origin known as "Gray Wall" or "Internal Browning."

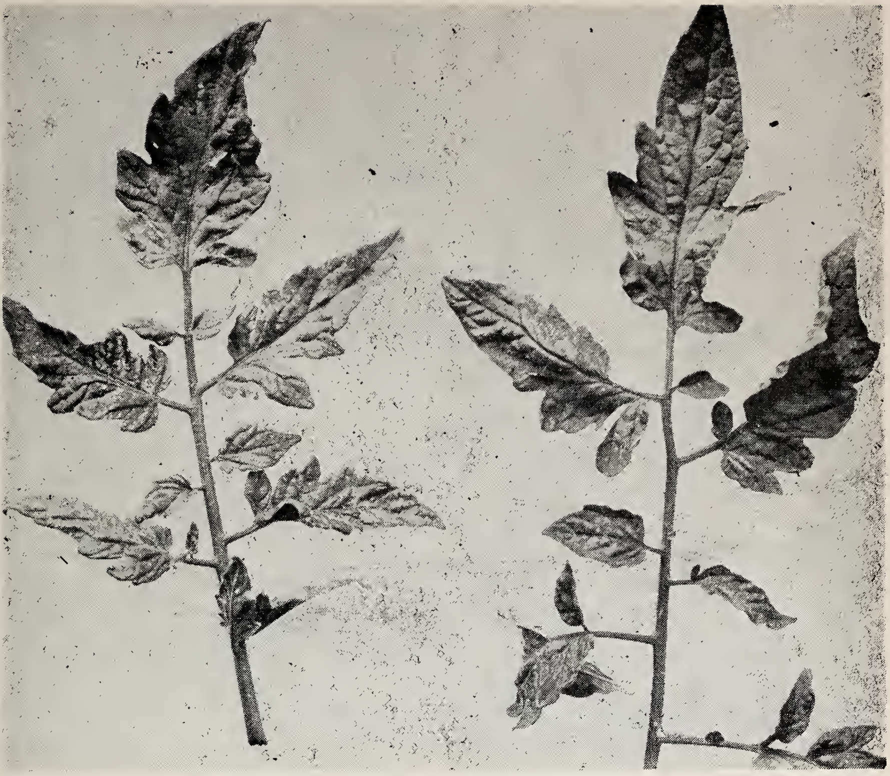

Fig. 41. Tobacco mosaic on tomato.

Mosaic. Two distinct groups of viruses cause mosaic in tomato, the tobacco mosaic group and the cucumber mosaic group. As each one of these two groups is composed of a large number of virus strains, the symptoms on the affected plant vary considerably depending on the particular strain of virus, the age of the plant at the time it becomes infected, and climatic factors, particularly temperature. In general, the leaves of mosaic-infected plants become mottled with light green or yellow areas interspersed with the normal green color (Fig. 41). The leaflets may become stunted and considerably distorted and malformed. Sometimes the leaves become very narrow and ribbon-like. In some cases (particularly when infected with certain virulent strains of the cucumber mosaic virus) the plant becomes greatly stunted, yellowish, and with multiple shoots bearing small malformed leaves, assuming a bushy, rosetted type of growth (Fig. 42). The stage of growth at which infection takes place is important. If the plant becomes infected when young, before it has set fruit, it is practically worthless; if it becomes infected when full grown (after the setting of the first two clusters of fruit), the damage from mosaic is small.

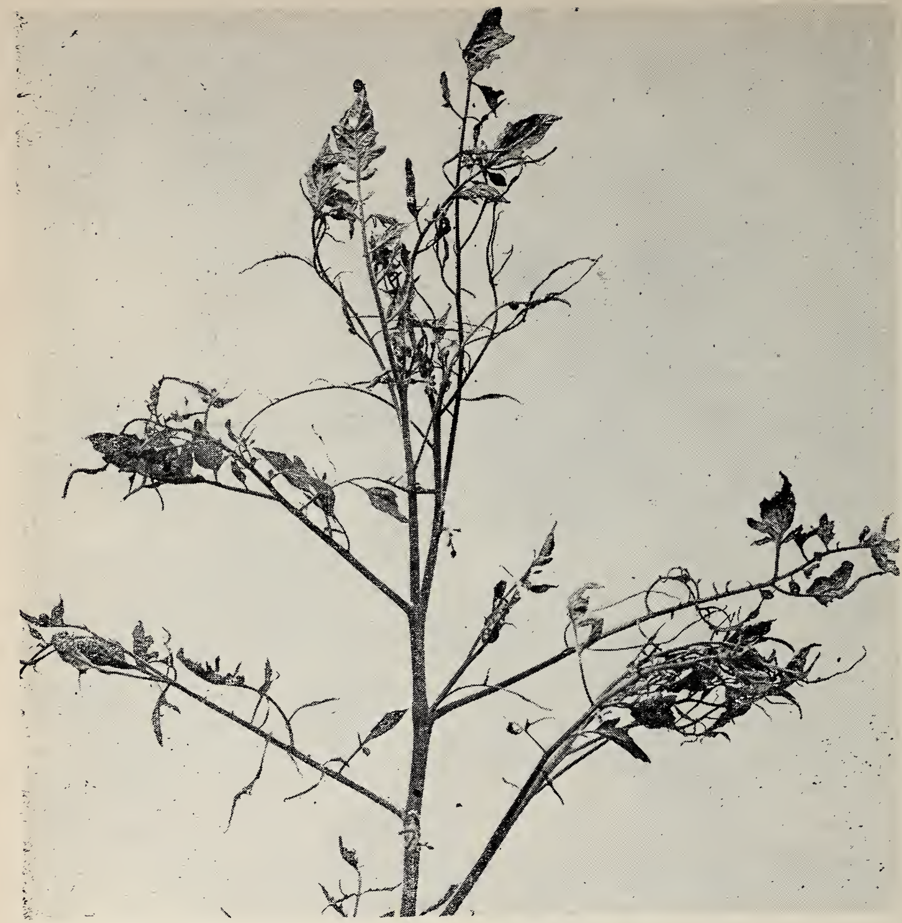

Fig. 42. Cucumber mosaic on tomato.

Control. Mosaic is a systemic disease. By this is meant that the causal agent of the disease is in the sap of the plant. Sprays and dusts, therefore, are ineffective against mosaic. Prevention is the only practical control measure against this disease. Mosaic is very infectious. It is spread by insects and by the handling of the plants by the workers, especially during the transplanting and pruning operations. The following preventive measures are recommended:

1. Prevent infection in the seedbed and cold frame by spraying or dusting periodically with some aphicide such as Black Leaf 40, rotenone, Vapotone, or malathion. This step is very important because, as explained above, plants that become infected in the seedling stage are worthless.

2. Remove or kill all weeds around seedbeds and cold frames. Both the tobacco and cucumber mosaics go to many different weeds, and aphids feeding on them can pick up the viruses and

transfer them to the tomatoes.

3. Avoid the use of tobacco, chewing especially, when handling tomatoes. Tobacco mosaic virus survives in tobacco even if it is dried and cured, and it spreads very readily by contact.

4. Since mosaic can be spread very easily from diseased to healthy plants by means of the pruning knife, reduce the pruning operation to a minimum. Remove the side shoots up to the first flower cluster, then prune no more. Most of the suckers and side shoots can be jerked off by hand without using a pruning knife and without touching the rest of the plant.

5. Do not plant the fall crop of tomatoes near any surviving plants of the spring crop. By the end of the summer any surviving tomato plants from an early planting are almost invariably infected with mosaic which may easily spread to the new plants by insects. Also, the fall crop should, as far as possible, be planted away from peppers and from garden flowers such as petunias and zinnias, for the mosaic virus can infect all these, as well as many other plants.

Gray Wall (Internal Browning). This disease, which is also known as "core rot" and as "blotchy ripening," is of recent origin. It was first reported from Texas in 1946. Since then, it has been reported from many other states —Florida, New Jersey, New York, Pennsylvania, Ohio. It was observed in Louisiana for the first time in 1952. Thus far it appears to be localized in St. Bernard and Plaquemines parishes, where it has caused severe losses in some plantings.

Description. Symptoms on foliage are not at all characteristic, just a few faint yellow spots. The symptoms on the fruit are very striking. Fruit is affected when it is nearing maturity. Affected fruit becomes hard and somewhat ridged. Irregular grayish to brownish blotches develop on the fruit wall as the fruit approaches maturity. These blotchy areas do not color normally. It is this feature that suggested the designation "blotchy ripening." The tissue inside the wall is brown in color and may show pits or cavities, formed by the collapse of the tissue. In advanced stages, the brown discoloration extends to the core. Usually, only the first and second clusters of fruit are affected. The plant then recovers, and produces normal fruit. The damage of the early fruit constitutes a severe loss to the grower because it is the early crop that sells at a high price.

Cause. This disease is new and not all the facts about it are known. However, experimental evidence obtained elsewhere (Pennsylvania State University) indicates rather conclusively that the disease is caused by certain strains of tobacco mosaic virus. The disease on the fruit develops only when the plant becomes infected by the virus at the time the fruit is nearing ripening. This is interpreted as a "shock" reaction. If the plant becomes infected earlier, the foliage will show mosaic symptoms but the fruit will not be affected. After the initial shock, the plant becomes adjusted to the virus, and this is the reason why fruit maturing later is not affected.

Studies on this problem are in progress by the Plant Pathology Department, Louisiana Agricultural Experiment Station, and it is hoped that in time we shall have more definite information about this important disease and its control.

Control. Follow the same preventive procedure as for mosaic.

Section II. Fruit Diseases

APPLE

Fire Blight
(Erwinia amylovora)

(See Pear, page 96.) Apples are more resistant to fire blight than pears.

Rust
(*Gymnosporangium* spp.)

Description. The rust fungus passes part of its life on the apple and part on the cedar (Fig. 43). On the cedar it forms the well-known swellings or galls ("cedar apples"). On the apple it causes spots on leaves, fruit, and sometimes on young twigs. The spots on the leaves and fruit are orange-yellow in color and a blister or cushion forms in the center of each spot.

Control. Since the rust requires both the apple and the cedar to complete its life cycle, the most effective way to control it is to eliminate the cedar trees. In many of the commercial apple-growing regions, the general practice is to destroy all cedars for a distance of about one mile around the apple orchard. In Louisiana, where apples are not grown commercially, this method cannot be recommended, for the cedars are usually more valuable than the apples.

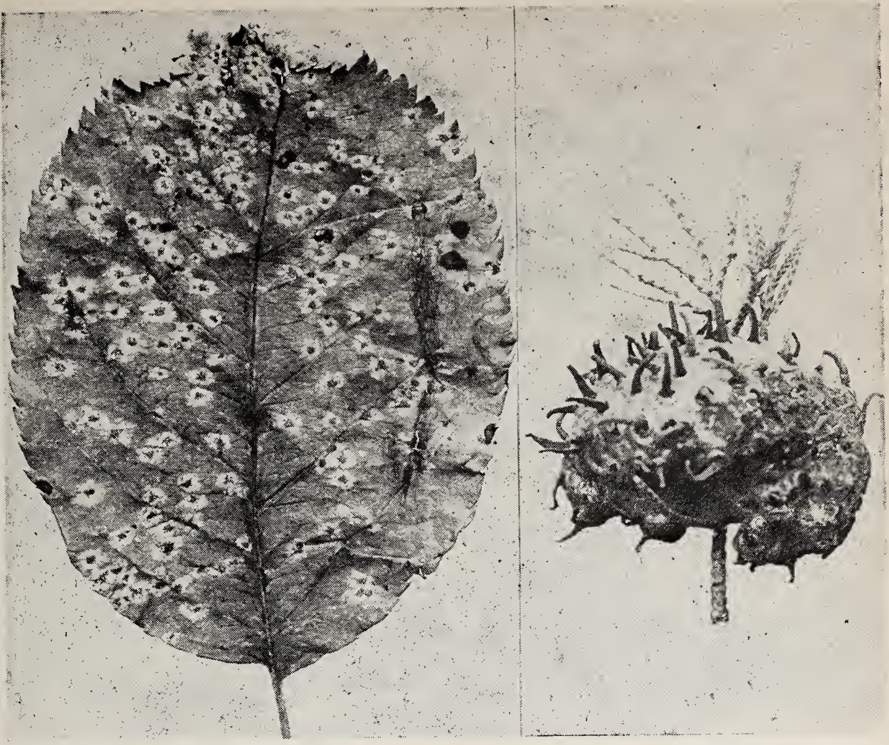

Fig. 43. Apple rust. (A) Rust spots on apple leaf. (B) Rust gall ("cedar apple") on red cedar.

Rust can also be controlled by spraying. Ferbam (Fermate) is the most effective fungicide against the apple-cedar rust.

Fruit Rots

Several fungous diseases affect the apple fruit at various stages of its development, causing spots and rots. The most important of these, in this part of the country are:

1. **Blotch** *(Phyllosticta solitaria)*. Dark-brown to black blotches with irregular margins on the fruit. Small angular spots on the leaves, and cankers on the twigs. Apple varieties differ greatly in susceptibility, some being very susceptible and others highly resistant.

2. **Black Rot.** (See Pear, page 100).

3. **Bitter Rot** *(Glomerella cingulata)*. This is the most important apple disease in the southern states. The disease affects the fruit as it approaches maturity. It forms sunken, more or less soft and watery, pinkish to brown rot spots on the fruit (Fig. 44). The rotted tissue has a bitter taste.

Control. In commercial apple orchards the various fruit rots are effectively controlled by following rigid spraying schedules. In small

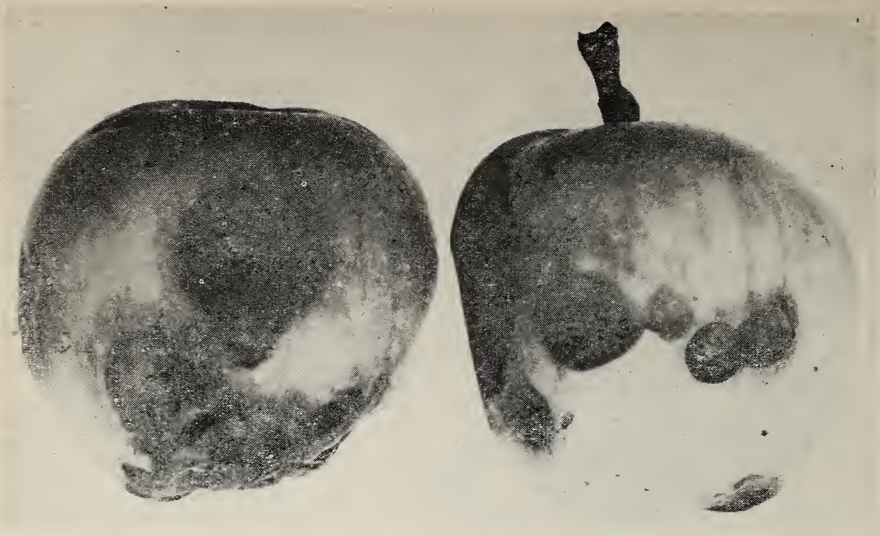

Fig. 44. Bitter rot of apple fruit.

home orchards where facilities for adequate spraying are usually lacking, control of these diseases is difficult. Sanitary measures are helpful in keeping them in check. All dead wood and all rotted and mummied fruit should be removed and burned.

Spray Schedule for Apples

(The spray schedule, if followed, will insure reasonably clean fruit, although it is not calculated to give complete control.)

Time of Application	Spray Mixture		Pest
1. Dormant, Dec.-Jan.	Oil Emulsion Water	2 gals. 50 gals.	San Jose scale, when present
2. Pink clusters, buds separated	Fermate Water	1½ lbs. 50 gals.	Scab Rust
3. Calyx (¾ petals fallen)	Fermate Hydrated lime Lead arsenate Water	1½ lbs. 3 lbs. 1½ lbs. 50 gals.	Scab Worms Rust
4. Two weeks after petals fall	Same as No. 3		Scab Worms Rust
5. When apples are well grown but not ripening	Copper sulfate Hydrated lime Lead arsenate Water	4 lbs. 4 lbs. 1½ lbs. 50 gals.	Blotch Bitter rot Worms

BLACKBERRY and DEWBERRY

Leaf Spots

There are several fungi which cause spotting of the foliage of blackberries and dewberries (Fig. 45). Two of these, *Cercospora rubi* and *Septoria rubi*, are the most common ones in Louisiana. Sometimes these leaf-spotting diseases cause considerable defoliation of the plants by late summer and this naturally affects the vitality of the plants and their fruitfulness the following spring.

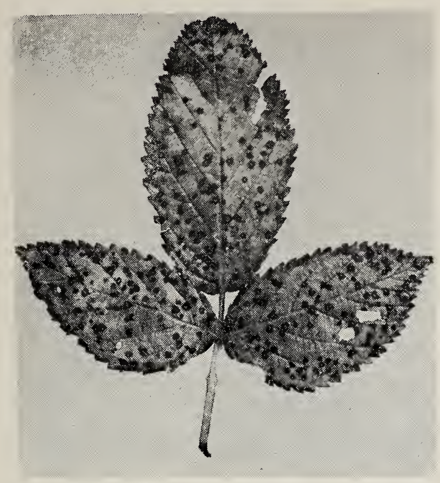

Fig. 45. Septoria leaf spot of blackberry.

Control. No tests have been made in Louisiana aimed directly toward the control of blackberry and dewberry leaf spots. However, in the course of some spraying experiments for the control of the rosette disease (see below), it was noted that the 4-4-50 Bordeaux mixture controlled the leaf spots very well. The sprayed plants reached late summer with green foliage while the nonsprayed ones were badly spotted and defoliated. Whether or not it would be economically profitable to spray blackberries and dewberries for the control of the leaf spots is a matter for the grower to determine, but it would seem that one application of 4-4-50 Bordeaux before blooming and about two more applications later on, during June and July, should keep the leaf spotting diseases in check.

Cane Blight

In the spring, some of the fruit canes appear weak and have dead patches or cankers on the bark. As the weather warms, some of these die back. There are several fungi that can cause cane blight. *Leptosphaeria coniothyrium* is the most common one in Louisiana. Winter injury is a contributing cause. This is especially true in South Louisiana where the plants do not become dormant in the fall but continue active growth until there is a killing frost.

Control. Cut out and burn all the old canes as soon as the fruit is harvested. This will not completely control cane blight, but will help by eliminating the main source of infection.

Rosette

(Cercosporella rubi)

Description. The rosette disease is very striking and very easy to recognize (Fig. 46). In the spring diseased canes give rise to multiple shoots which produce a bunchy type of growth (witches' brooms). The diseased flower buds are loose, puffy, and elongated, instead of being round and compact like the healthy ones. Diseased flowers do not set fruit and sometimes the flower parts become leaf-like in growth. After the flowers begin to wither they become covered on the inside with a white powder which is made up of the spores of the fungus.

Control. Control measures recommended for rosette will be better appreciated if a brief descrip-

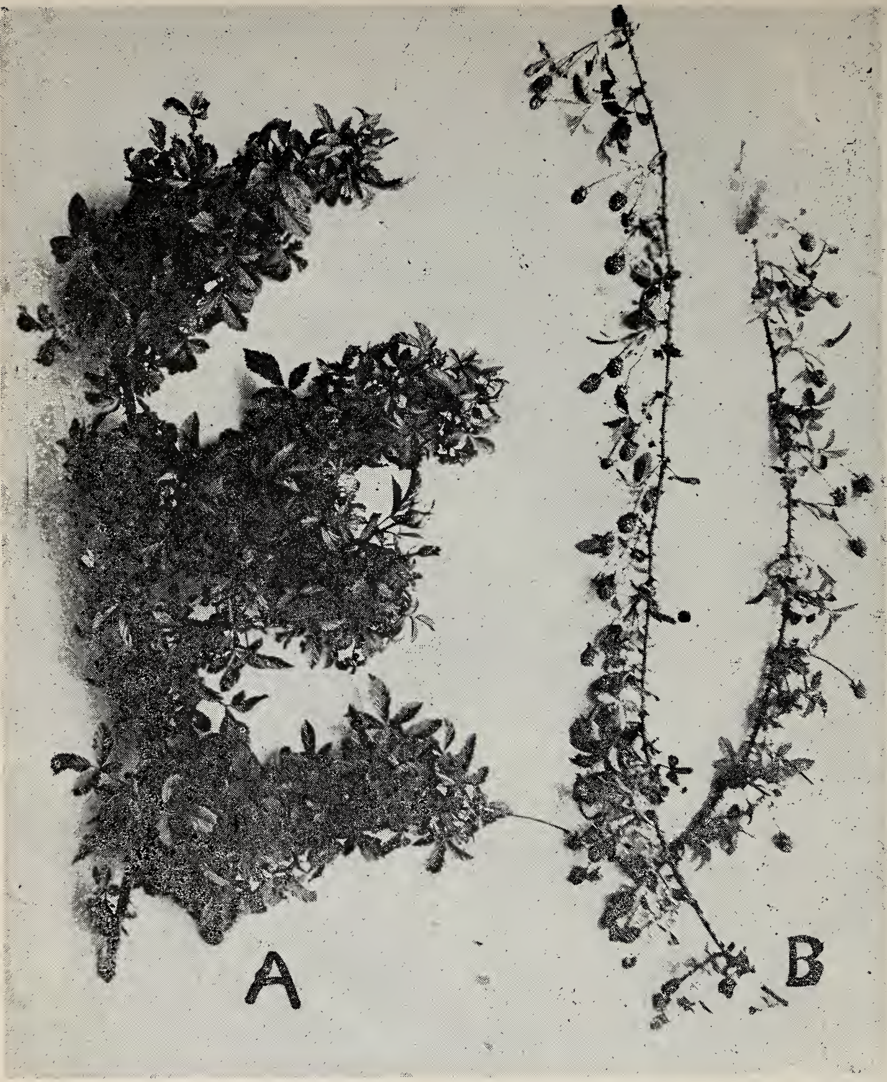

Fig. 46. Rosette on dewberry. (A) Diseased cane. (B) Healthy canes. Note that the rosette cane has no fruit.

tion is given of the cycle of development of the disease. The fungus *(Cercosporella rubi)* which causes the rosette disease produces spores only on the withered blossoms in the spring. When the spores fall on the new canes they germinate and grow inside the buds. Infected canes do not show any disease symptoms until the next spring. The period during which the new canes are susceptible to infection is limited. No infection takes place after about the first of June.

Summary of Control Measures

1. Do not allow any wild blackberries or dewberries to grow

close to your berry plantings, as the rosette disease will spread from the wild to the cultivated vines.

2. Inspect the plantings in the spring and remove any rosette growth that may be present. This will eliminate the source of infection from the immediate vicinity of the plants. This cutting off of the rosette growth should be done early in the spring (preferably in February) before the opening of the blossoms, that is, before the spores of the fungus have been formed.

3. Prune all the new canes to the ground about the first week in May. This will eliminate all the canes that may have become infected up to this period.

4. Spray the new canes that develop from the time of pruning until the first week in June with 4-4-50 Bordeaux. The spraying should be done about every 10 days. Two to three sprayings should be sufficient.

5. Do not plant dewberry plants that come from tip layering of rosette canes.

Rust

Description. Two kinds of rust occur on blackberries and dewberries, the orange rust *(Kunkelia nitens)* and the yellow rust *(Kuhneola uredinis)*.

The orange rust forms orange-colored masses of spores on the undersides of the leaves. It occurs just as soon as growth starts in the spring and usually covers all the new growth of the plant.

The yellow rust appears later and occurs as scattered yellow pustules mostly on stems, but also on leaves, throughout the summer and fall.

Control. The yellow rust is not important and there is no need to attempt to control it. The orange rust, on the other hand, is very destructive. It is systemic within the roots and crown of the plant and therefore it cannot be controlled by sprays or dusts. The affected plants should be dug up, roots and all, and burned.

Crown Gall

(See Peach, page 92.)

CITRUS

Citrus trees and their fruits are subject to a very large number of diseases. No attempt is made to describe or discuss all the citrus diseases in this bulletin. Only the most common ones are considered.

Scab

(Sphaceloma fawcettii)

Scab is primarily a disease of satsuma orange, tangerine, grapefruit, lemon, sour orange, and *Citrus trifoliata*. It does not affect the sweet orange. Scab affects fruit, leaves, and young shoots, causing irregular, raised, corky, scabby, wart-like outgrowths (Fig. 47). Severely scabbed leaves and fruits become mis-shapen and distorted. The rind of scabbed fruit is thick and puffy.

Control. Scab control is based on the fact that infection occurs only on young, immature growth, provided there is sufficient moisture in the atmosphere and that the temperature is neither too high nor too low (about 59° to

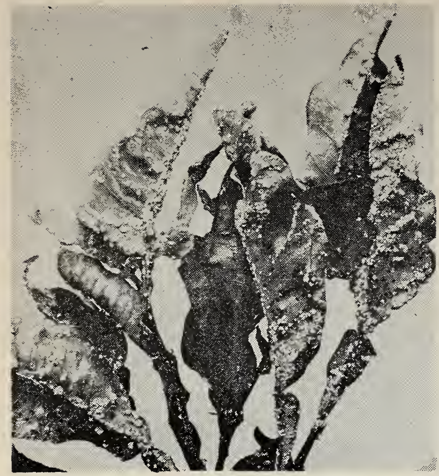

Fig. 47. Scab on sour orange.

74° F. is the optimum). This combination of conditions usually prevails during the flush period of growth in the spring and it is during this period that the trees should be sprayed. (See Spray Schedule, page 79.)

Melanose

(Diaporthe citri)

Description. Like scab, melanose is caused by a fungus *(Diaporthe citri)*, and it also affects leaves, shoots, and fruit. It forms numerous, dark brown dots or spots on the leaves, young shoots, and fruit (Fig. 48). These spots are at first sunken, but later become raised so that the russeted area has a rough, sand-paper feel. The spots may be irregularly scattered on the surface of the fruit, or they may run in streaks (tearstains). Like scab, melanose infection occurs only on young, tender growth. The fruit becomes progressively resistant with age. However, the same fungus that causes melanose can infect the ripe fruit after harvest. It is one of the two most common causes of the very destructive fruit decay known as stem-end rot. Control of melanose, therefore, helps to reduce the losses from stem-end rot.

Control. Two methods are used for the control of melanose—sanitation and spraying. To obtain effective control of melanose on the fruit, it is necessary to spray during the critical period of maximum susceptibility to infection; that is, within one to three weeks after fruit set.

1. Sanitation. The melanose fungus does not produce spores on the living parts of the plant (leaves, shoots, and fruit), but only on dead twigs and branches. Therefore, pruning and burning the dead wood is a great help in

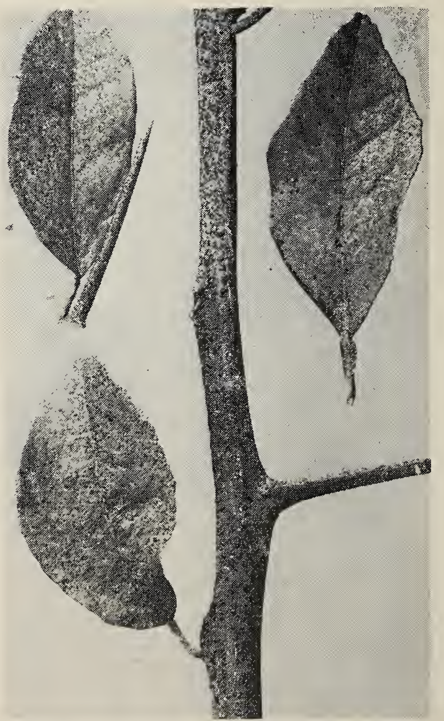

Fig. 48. Melanose on sweet orange.

controlling this disease because the practice eliminates much of the source of infection.

2. **Spraying.** (See Spray Schedule, page 79.)

Sooty Mold

Description. The sooty mold fungus *(Capnodium citri)* is not a parasitic organism. It does not penetrate the tissue of the plant but grows superficially on the honeydew excretions of white flies, aphids, mealy bugs, and scale insects. Sooty mold causes a certain degree of injury when its growth is very thick by preventing the sunlight from reaching the leaf, and by making the fruit black and unattractive. Fruit that is covered with sooty mold is smaller in size and does not color well.

Control. Sooty mold is controlled indirectly by controlling insects (white flies and scale) which excrete the honeydew on which the sooty mold fungus grows. When these insects are killed the sooty mold disappears. (See Spray Schedule, page 79.)

Lichens

Description. Growth of different kinds of lichens (commonly called "moss," locally) often occurs on trunks, branches, and sometimes on leaves of citrus trees. Lichen growth is less abundant on healthy, vigorous trees than on neglected, weakened trees which are growing poorly. For this reason the presence of lichens is often blamed for the unthrifty condition of the trees, when in fact the reverse is true; the lichen growth is abundant because the tree is unthrifty from some other cause. Lichens are generally considered harmless. They are not parasitic, do not invade the tissue of the bark, and cause no damage to the tree. An exception to this general statement may be made in the case of one kind of lichen *(Melanotheca* sp.). This species, which makes a grayish, compact, pimply type of growth on trunks and branches, probably causes a slight damage. The bark underneath the lichen growth, although not killed, appears damaged. It is somewhat sunken and brownish in color.

Control. Lichens are easily controlled by spraying with Bordeaux or with other copper fungicides. The regular spray schedule (page 79) for the control of other diseases is usually sufficient to control the lichens also. If desired, stronger concentrations of Bordeaux mixture, 4-4-50 or 5-5-50, may be applied to the trunk and branches for the control of lichens.

Fruit Rots

Because the bulk of the fruit is sold locally, mostly on the New Orleans market, almost as soon as it is picked, the Louisiana citrus grower is not confronted with the serious problems of storage and transit rots that the citrus shipping states have to face. This does not mean that fruit rots are not important. Even though the grower may dispose of his fruit before it rots, some one along the line, whether it be the commission merchant, the grocery man, or the housewife, will suffer a loss if the fruit rots before it is consumed, and this loss will ultimately be passed back to the grower in the form of lower prices. Therefore, every effort should be made to prevent fruit decay.

In considering means of keeping losses from fruit rots to a minimum, the following facts should be kept in mind: (1) fruit rots are caused by parasitic fungi (molds) which invade the tissue of the fruit and cause it to rot; (2) these molds infect the fruit for the most part through cuts, wounds, bruises, thorn pricks; (3) the spores of these molds are produced in vast numbers on dead twigs and branches and on rotten fruits; and (4) moisture is necessary for the germination of the spores.

With these facts in mind, the precautions to be taken for preventing fruit rots are obvious. Fruit should not be picked when wet, or, if picked when wet, provisions should be made for drying it as soon as possible. No decaying fruit should be allowed to stay in or in the vicinity of the packing house. If the fruit is washed, it should be dried as rapidly as possible. Borax, at the rate of 5 to 8 per cent, either in the wash water or in a separate dipping tank, helps to keep down fruit rots, particularly the blue and green molds.

Nutritional Troubles

It is known that some nutritional troubles, caused by deficiencies of one or more of the so-called "minor" or "trace" elements (boron, copper, zinc, manganese) do occur in some of the citrus groves in Plaquemines Parish. These deficiency diseases are characterized by various chlorotic patterns on the foliage, by die-back of twigs, by growth abnormalities, and by some effects on the size, shape, and taste of the fruit.

Nutritional deficiencies are corrected either by soil or by foliar application of the needed element. Soil applications are not always effective. In certain soils, especially those with alkaline reaction, the needed element is "fixed" or "inactivated," that is, it is taken out of solution, and cannot be absorbed by the roots. In such cases, the element can be applied as a spray to the foliage.

The copper fungicide sprays used for control of fungus diseases will also correct copper deficiency. Manganese and zinc deficiencies can be corrected by the addition of manganese sulphate and zinc sulphate to the fungicidal or insecticidal sprays (see Spray Schedule). However, nutritional sprays should not be used indiscriminately. They add to the cost of production. It should first be determined whether or not a deficiency of any particular "minor" element exists.

Notes on Citrus Spray Schedule

(a). The term "neutral copper" refers to several proprietary copper fungicides that are sold under different trade names, such as "Copper A," "Copper K," "C.O. C.S.," "Tribasic Copper Sulphate," etc. The copper content of these compounds varies anywhere from about 25 per cent to 50 per cent. Follow the directions of the manufacturer as to the proper amount to use. For example, if a particular compound contains 50 per cent copper, use it at the rate of 2 pounds in 100 gallons of water; if its copper content is 30 per cent, use 3 pounds per 100 gallons.

(b). Spray oils come either as emulsions or as clear (miscible) oil. The per cent of oil varies with

CITRUS SPRAY SCHEDULE[1]

(For a better understanding of the spray schedule, read carefully "Notes on Citrus Spray Schedule" beginning on page 78.)

Time	Spray or Dust	For Control of
1. *Pregrowth. January-February.	A. For satsuma, grapefruit, Temple Neutral copper(a) 2-3 lbs., Oil emulsion(b) 2-3 gals., water 100 gals.	Scab, Scale Red Spider
Stop before blooming	B. Valencias Sulphur dust or spray	Rust Mites
	C. For all other round oranges Oil emulsion 2-3 gals. per 100 gals.	Purple and Red Scale
2. *After bloom. For satsumas when most petals have fallen. For other oranges when fruit is about pea size.	A. Satsuma, grapefruit, Temple Neutral copper(a) 3 lbs., wettable sulphur 8⅓ lbs., Malathion 1½ pints, water 100 gallons, Nutritional mixture if desired. See notes(c)	Scab, Scales, Mealy Bugs, Aphids, Red Spider
	B. For all other oranges Neutral copper(a) 2-3 lbs., wettable sulphur 8⅓ lbs., Malathion (e) 1½ pints, Ovotran (if oil in spray No. 1 has been omitted) 1 lb., Water 100 gals.	Melanose Scales Rust Mites Red Spiders Aphids
3. *Middle June-Middle July	For all citrus Oil emulsion (b) 1 to 1½ gals. Malathion(e) 1 pint Water 100 gals.	Scales White Flies Red Spiders Mealy Bugs
4. August	For all citrus Sulphur(d) dust, or wettable sulphur spray	Rust Mites
5. September	For all citrus Wettable sulphur 8⅓ lbs. Malathion(e) 1½ pints, Water 100 gals.	Rust Mites Red Spiders Scales White Fly Mealy Bugs

* The sprays marked with an asterisk are the most important ones for the home orchard.

[1] This schedule was prepared in consultation with Ralph Brown, superintendent, Plaquemines Parish Experiment Station, M. W. McEachern, county agent, Plaquemines Parish, and John A. Cox, horticulturist, Louisiana Agricultural Extension Service.

the brand. Follow the directions of the manufacturer as to the proper amount to use.

(c). Nutritional Sprays. Deficiencies of zinc and manganese occur in some of the groves. In such cases the use of nutritional sprays may be desirable. A nutritional spray may be made with 3 pounds of zinc sulphate, 3 pounds of manganese sulphate, and 1.2 pounds of hydrated lime in 100 gallons of water.

(d). Sulphur and oil are not compatible and will cause severe injury if mixed. Never mix oil and sulphur in the same spray, and always allow at least three weeks interval between oil and sulphur applications.

(e). Parathion may be used instead of malathion. Parathion is very poisonous, much more poisonous than malathion, and should be used with extreme care. Follow exactly the directions on the container.

Spray No. 1 (pregrowth) may be omitted partly or completely. If scab infection is not heavy, the copper component of the spray may be omitted; if scab has been bad the previous season, but scale and red spider infestation is light, the oil component of the spray may be left out; if both scab infection and scale and spider infestations are light or absent, omit spray No. 1 completely.

Virus Diseases

Citrus is affected by a large number of diseases caused by viruses, some of them extremely destructive. The three most important ones, Scaly Bark (*Psorosis*), Bark Shelling *(Exocortis)* of Trifoliata, and Tristeza (Quick Decline) are treated in this bulletin.

Scaly Bark
(Psorosis)

This disease is also called "California scaly bark" in order to differentiate it from *Leprosis,* an entirely different disease that occurs in Florida and which, in that state, is commonly called "scaly bark."

Description. Psorosis virus is composed of several strains, and, because of this, symptoms vary somewhat depending on the particular virus strain and the particular citrus species. The most prominent characteristic of the disease is the scaling of the bark. This starts in the form of small blisters which usually appear first on the older bark of the branches or trunk of trees that are five years old or older. Soon after the appearance of the bark blisters, the bark begins to scale off in flakes of dry bark of varying sizes (Fig. 49). The scaly area increases in size gradually until it girdles the branch or trunk. Gumming may or may not accompany the scaling. In the early stages, the inner bark and the wood underneath are not affected, but as the disease progresses, the wood becomes filled with gummy materials and reddish brown in color. The part of the branch above the scaly lesion (or the whole tree if the lesion is on the trunk) begins to show symptoms of distress: sparse foliage and dieback of twigs. The foliage also exhibits symptoms, usually small light-green to yellow flecks. The leaf symptoms usually appear long before the bark symptoms.

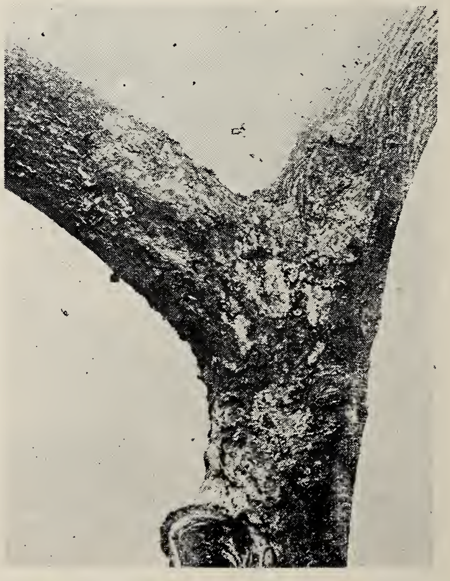

Fig. 49. Scaly bark ("Psorosis") on orange.

Control. The disease can not be cured but it can be prevented. The only known method of spread of the virus is by budwood. Budwood should be taken only from trees that are free of infection, and, since young trees (under 5 years) usually do not show bark symptoms, budwood should be taken from older trees (preferably 10 years old, or older) that are free of bark symptoms.

Exocortis (Bark Shelling, Scaly Butt)

This disease is important only in trees grafted on trifoliate orange *(Poncirus trifoliata)* rootstock and some of its hybrids.

Description. The most prominent characteristics of exocortis are (1) the shelling of the bark of the rootstock portion of the trunk (Fig. 50), and (2) the severe stunting of the growth of the tree. Comparative measurements of exocortis-affected and healthy navel orange trees in California showed the trunk diameter of the affected trees to be only ½ that of healthy trees and the average volume of the tops about 1/5 that of the healthy trees. The outer bark separates from the inner live bark and peels off in narrow, dry strips.

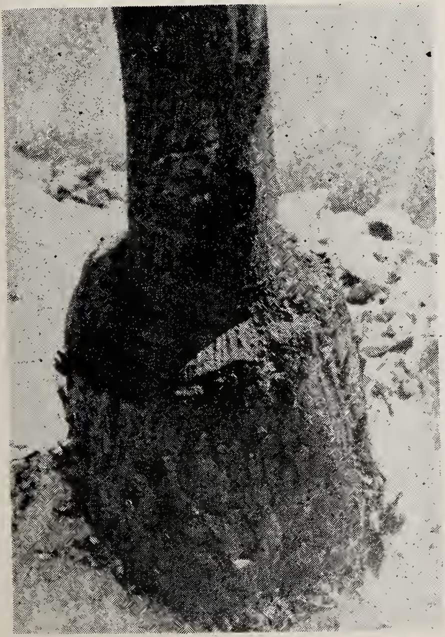

Fig. 50. Bark shelling ("Exocortis") on trifoliata orange rootstock. (From L. J. Klotz, "Gum diseases of citrus." Calif. Agr. Exp. Sta. Circ. 396.)

The dwarfing of the growth of the tree becomes apparent early, usually from the second year on; the shelling of the bark, however, does not usually begin to develop until after the tree is eight years old. This fact is important to remember in connection with control.

Control. Exocortis can not be cured, but it can be prevented in planting new groves. Prevention is based on these facts: (1) the virus may be carried in any species of citrus, but symptoms show only on trifoliate orange rootstocks. (2) Bark shelling, the most reliable diagnostic feature, does not develop until the tree is eight years old or older. (3) The only known way of spreading the infection is the use of infected budwood or of infected trifoliate seedlings. The following preventive measures are recommended.

1. Budwood should be taken from healthy trees, growing on trifoliate rootstock, and not less than 10 years old.

2. Seed for rootstock propagation should not be taken from trifoliate trees showing exocortis.

Tristeza (Quick Decline)

Tristeza, or quick decline, is the most destructive virus disease of citrus. It apparently originated in the Union of South Africa and from there has spread on transported citrus stock to practically all regions of the world where citrus is cultivated. It has destroyed most of the orange groves in Argentina and Brazil. It appeared in California about 1939 and has killed thousands of orange trees there. It was found in Louisiana in 1950, and in Florida more recently. There are indications that the disease had been present in both Louisiana and Florida several years before it was recognized, but, for reasons that are explained below, it has not spread so widely in this country as in other parts of the world.

Description. The symptoms of tristeza are rather indefinite and difficult to describe. As the name (Quick Decline) indicates, the disease causes the tree to go into a state of rather rapid decline. The leaves are smaller than normal and of a dull, pale-green to yellow color. Shedding of foliage, from the base of the shoot upward, often takes place. In older trees, there is a partial to complete suppression of flushes of new growth. There is a dying back of twigs and larger branches. In the early stages of infection, affected trees bloom profusely and set a heavy crop of fruit. The small feeding rootlets, first, and later larger roots, die and decay. The whole tree then may die within a few months or 2 to 3 years. In some cases, however, the disease becomes chronic; the tree may remain alive indefinitely but in a weak, unproductive condition. It is known that tristeza virus is composed of strains that vary in virulence, and it is believed that trees that survive the attack and go into a chronic unthrifty condition are infested with a mild strain of the virus.

Resistant and Susceptible Rootstocks. Tristeza is primarily a disease of sweet orange on sour orange rootstock. This is by far the most susceptible scion-rootstock combination. Several other scion-rootstock combinations are susceptible, but to a less degree. The following is a list of resistant and susceptible rootstocks:

Resistant

Trifoliate orange (Poncirus trifoliata)
Most mandarins (Cleopatra in particular
Rangpur lime (a mandarin hybrid)
Sweet orange
Rough lemon
Some tangelos and citranges

Susceptible

Sour orange
Grapefruit
Shaddock
Pummelo
Some acid lemons
Some limes
Some tangelos

Transmission of Tristeza Virus. In nature, the virus is spread by two means; (1) by insects (aphids), and (2) by the use of infected budwood.

The most efficient vector (spreader) of the virus is a species of citrus aphid *(Aphis citricidus)*. This species is prevalent in many parts of the world, and is responsible for the very rapid spread of tristeza and the wholesale destruction of the citrus orchards in South America. Fortunately, this species of aphid is not known to occur in North America, and this accounts for the relatively slow spread of the disease in this country. Two other species of aphids, the melon aphid and the green citrus aphid, which occur in this country, are capable of spreading the virus, but both of these are very inefficient vectors and, therefore, not of great importance.

Most of the spread of tristeza in this country has been due to the use of infected budwood. Many species and varieties of citrus growing on their own roots, or on tolerant rootstocks (sweet orange on trifoliata rootstock, for example) may carry the virus without showing any disease symptoms.

Control. From the preceding discussion, it becomes plainly evident that in areas where the tristeza has been introduced, the most practical means of control is the use of tolerant rootstocks. In Louisiana, the most common rootstocks in the past were sour orange, trifoliate orange, and shaddock. Of these, sour orange was most widely used because it is compatible with most species and varieties of citrus and resistant to root rot and foot rot. Now that the tristeza has been introduced into the Louisiana citrus area, both sour orange and shaddock are definitely out as rootstocks. This leaves the trifoliata orange as the only tried rootstock, and, while trifoliata possesses many admirable qualities, such as resistance to cold, root rot, and tristeza, it also possesses some disadvantages, such as incompatibility with some varieties and susceptibility to bark shelling (Exocortis). There is, therefore, a pressing need for a suitable tristeza-resistant rootstock to take the place of sour orange.

Of the tristeza-tolerant rootstocks listed above, sweet orange is not suitable to Louisiana conditions; it is susceptible to root rot and foot rot. Some mandarins, particularly the Cleopatra, and some citranges, appear promising. These, together with several other citrus species and hybrids, are being tested at the Plaquemines Parish Experiment Station, and it is hoped that suitable substitutes for sour orange will be found.

FIG[4]

Leaf Blight

(Caused by several species of *Pellicularia)*

The Pellicularia leaf blight is the most serious disease affecting fig trees in Louisiana. There are three different species of Pellicularia that cause blighting of fig leaves. They are very much alike in general symptoms and the control measures are the same for all three types; for this reason they are grouped together.

Leaf blight usually appears late in May or early in June. The worst damage usually occurs during prolonged rainy spells. Leaves and fruit are attacked by the leaf blighting fungi. The injury is confined to the loss of leaves and fruit.

Description. The blight first shows up as irregular-shaped brown spots on the leaves. Infection usually starts at the base of the leaf and spreads in a fan-like manner, forming a large semi-circular brown discolored dead-spot.

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[4] The section on Fig diseases was prepared by Dr. E. C. Tims.

Infected leaf tissues may shrivel up and fall out, producing a shot-hole effect, or the edges of the leaves may slough off, leaving them ragged in appearance. Some leaves may have the white or light brown colored, powdery-looking fruiting layer of the Pellicularia on the lower surfaces. When conditions are favorable, large numbers of leaves may be completely killed within a few days, leaving some limbs completely bare. Most of the damage occurs before the fruit ripens. On the limbs where the leaves are killed the fruit usually shrivels up or does not ripen properly.

The three fungi that cause leaf blight of fig are: (1) *Pellicularia koleroga* (the thread blight fungus) which produces small, brown, shiny hyphal threads on the small twigs, petioles, and leaves, and irregular-shaped, brown sclerotia on the twigs (Fig. 51). Leaves killed by this fungus usually hang on to the twigs by the small hyphal threads in a characteristic way. (2) *Pellicularia filamentosa* is characterized by the production of large numbers of small, brown sclerotia about half the size of mustard seed on the twigs, fruit, and leaves. (3) An undetermined species of *Pellicularia* which differs from the other two forms in the absence of any definite sclerotia or hyphal threads.

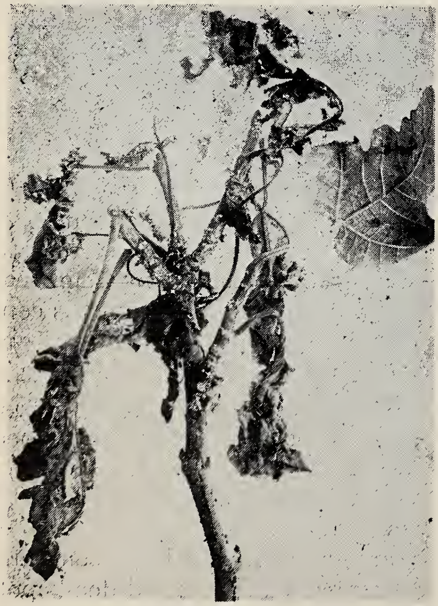
Fig. 51. Thread blight on fig.

Control. The fig leaf blight can be controlled rather easily under most conditions by the use of copper sprays. One or two applications of Bordeaux mixture 4-4-50 between May 10 and June 1 are usually sufficient to keep the leaves on the trees until after the fruit has ripened. Bordeaux mixture should not be applied later than a month before the figs ripen because of possible objectionable staining of the fruit. Another compound that is easier to prepare than Bordeaux mixture has proved to be effective against leaf blight. Tribasic copper sulphate, 3 pounds to 100 gallons water, applied in late May or early June usually gives good control. In periods of rainy weather it may be necessary to make one or two additional applications.

Rust

(Physopella fici)

Description. Rust is caused by *Physopella fici,* a fungus which is widespread over the State. It first appears as small yellowish to reddish pustules on the lower surface of the leaves (Fig. 52),

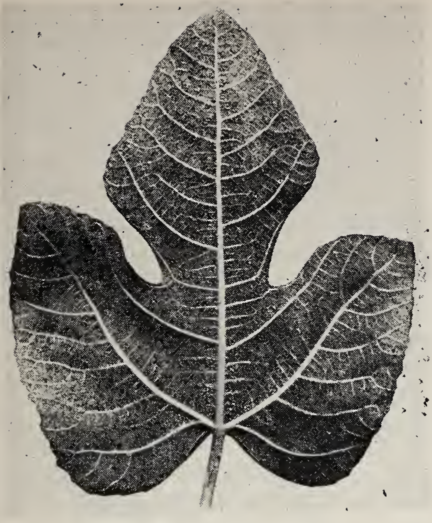

Fig. 52. Fig rust.

which enlarge and become more numerous until almost the entire surface may be involved. Many fig trees are completely defoliated by rust before the end of the summer, although the disease seldom develops early enough to damage the leaves seriously before the fruit ripens. The only serious aspect of the disease is premature defoliation of the trees.

Control. The sprays used for the control of leaf blight will usually give sufficient protection against rust. If no spraying has been done for the leaf blight, a wettable sulphur spray (4 pounds in 50 gallons of water) applied in late May or early June (before fruit ripening) will give satisfactory prevention of rust. The same spray should be used after the fruit has been harvested to prevent premature defoliation of the tree by the rust.

Cercospora Leaf Spot

Description. This leaf spot, caused by *Cercospora fici,* is widespread in the State, but causes only slight damage. The spots are brown in color, roughly circular in shape, and vary in size up to about ½ inch in diameter. The spots may coalesce to form larger areas of dead tissue.

Control. Control measures are usually unnecessary. Bordeaux mixture applied in May or early June will greatly reduce Cercospora leaf spot.

Limb Blight

Description. This disease is caused by the fungus *Corticium salmonicolor.* It is characterized by the sudden dying of twigs or branches up to 2 inches or more in diameter, with the production of bright pink color on the bark of the diseased twig (Fig. 53).

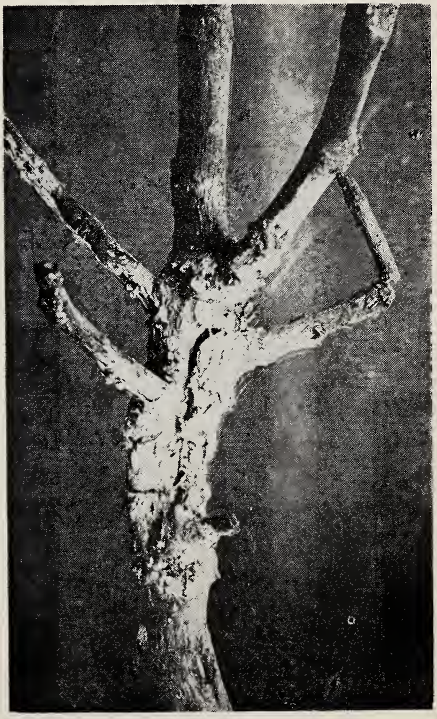

Fig. 53. Limb blight of fig.

The leaves on the dead twigs usually turn a dark brown color and hang on for weeks after they are killed. This type of limb blight often recurs in the same trees year after year, sometimes causing considerable damage.

Control. Prune out the affected branches, making the cut about 6 inches below the dead bark, and either paint the cut surfaces with Bordeaux paste (see page 114) or spray the tree with Bordeaux mixture.

Fig Canker

The fig canker is caused by the fungus *Tubercularia fici.* It is widely scattered over the State and causes some damage to many trees. The cankers appear as irregular-shaped swellings with sunken areas in the center. They partially girdle the twigs and small branches, killing some and weakening others so they break easily.

Control. The cankers should be cut out.

Stilbum Disease

Description. This disease is caused by a fungus called *Stilbum cinnabarinum.* It causes a dying of twigs and even limbs on fig trees. Diseased areas are characterized by the presence of small pink fungus heads borne on short stalks growing on the bark. Infection takes place through wounds of various types, and may occur through the leaf scars on small twigs.

Control. Control measures are rarely necessary for the Stilbum disease, but where it occurs, the infected branches can be pruned out.

GRAPE

In discussing diseases of grapes, the varieties of grapes grown should be considered. Grapes are not grown commercially to any extent in Louisiana. In home gardens, two types of grapes are grown, the muscadines and the American bunch grapes.

From the practical standpoint, the muscadines are relatively free from diseases. The black rot fungus causes considerable spotting of the foliage, especially of the Scuppernong variety, but it does not affect the fruit to any appreciable extent. Two other fungi, *Cercospora* sp. and *Isariopsis clavispora,* also cause spotting of the leaves late in the season, but they are not serious. In general, it may be safely stated that none of the diseases affecting the muscadine grapes causes sufficient damage to justify control measures.

The bunch grapes, on the other hand, are subject to many serious diseases, and unless one is prepared to practice control measures, one should not attempt to grow bunch grapes in Louisiana. The following are among the most important diseases of bunch grapes.

Black Rot

(Guignardia bidwellii)

Description. The black rot fungus affects the leaves, berries, fruit stems, and sometimes the young canes. It causes numerous definite brown dead spots on the leaves. The berries are affected in all stages of their development but most severely when they are one-half to two-thirds grown. The rot on the berries starts as a purplish or brown spot which spreads fast and soon rots the entire berry, which turns black in color and later dries and shrivels. The dried, mummified berries remain attached to the stem (Fig. 54).

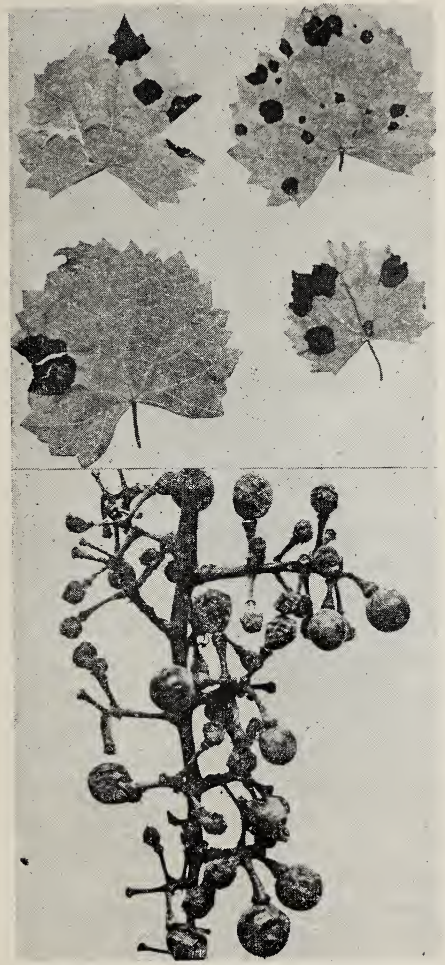

Fig. 54. Black rot of grape. Symptoms on leaves and fruit.

Control. Spray with Ferbam (Fermate), 1 pound to 50 gallons of water, (1) when new growth is about 1″ long, (2) just before bloom, (3) two weeks after bloom, (4) two weeks after the third application, and (5) when fruit is about half-grown. Cryolite at the rate of 3 pounds per 50 gallons may be added to the Ferbam spray to control chewing insects.

Anthracnose

(Elsinoe ampelina)

Description. Like the black rot, the anthracnose fungus attacks the leaves, shoots, fruit stems, and berries. On the leaves the spots are small, angular, with pale-brown centers and reddish-brown margins. On the berries, the spots are circular, sunken, and each is surrounded by a purplish to dark-colored border (Fig. 55). The appearance of the rotted spots on the berries has given this disease the common name of "bird's eye rot." Spots, somewhat similar to those on the berries, develop also on the young shoots. Sometimes the spots are so numerous that the young shoots are girdled and killed.

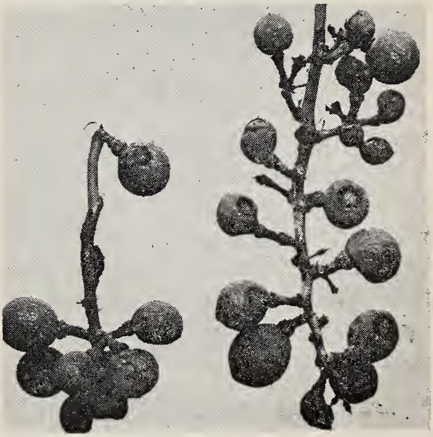

Fig. 55. Anthracnose of grape.

Control. Same as for Black Rot.

Peach and plum are grouped together here for the reason that these two crops have many diseases and insect pests in common, and for the most part the same control measures are applicable for both.

Scab

Description. Scab is caused by a fungus, *Cladosporium carpophilum.* It is characterized by greenish to black spots on the peach fruit (Fig. 56, A). The spots are usually localized on one side of the fruit near the stem end. When the infection is severe, the scabby part of the fruit cracks. The disease also forms irregular blotches on leaves and small cankers on tender twigs.

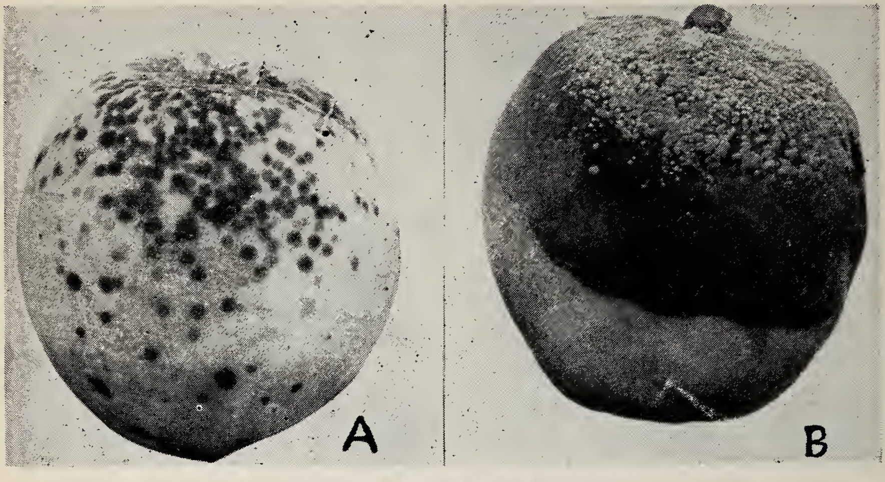

Fig. 56. (A) Peach scab. (B) Brown rot.

Control. See Spray Schedule, page 93.

Bacterial Spot and Canker

(Xanthomonas pruni)

This disease, which is caused by bacteria, affects both peach and plum. It causes spots on the leaves and fruit and cankers on shoots and branches (Fig. 57). The dead tissue of the spots on the leaves often separates and falls out, leaving conspicuous "shot-holes." On the fruit the spots are small, circular, dark brown, and somewhat sunken. Two kinds of cankers form on the shoots, *spring cankers* and *summer cankers.* The spring cankers develop on young, tender shoots of the previous summer growth. They appear as water-soaked somewhat darkened blisters about the time of leafing. At first they are small, but enlarge gradually to form brown to purplish lesions about ½ inch long. The summer cankers develop on the still green shoots in late summer. They are thick-edged, somewhat raised, and quite conspicuous. The summer cankers result from infection from bacteria in spots on the leaves. The bacteria

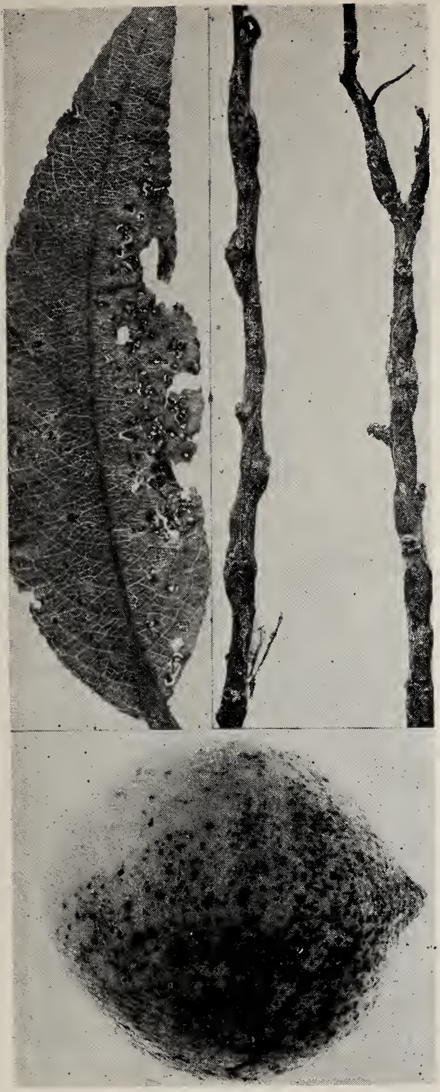

Fig. 57. Bacterial spot and canker of peach. Symptoms on leaves, shoots, and fruit.

then over-winter in these summer cankers and infect new growth in the spring. Therefore, control of the disease by the use of fungicidal sprays is directed, for the most part, toward killing the bacteria in the twig cankers.

Control. No completely satisfactory control is known for bacterial spot. However, certain practices help to reduce the incidence of the disease and reduce losses. (1) As a preventive measure, nursery stock should be carefully inspected and any trees showing swollen cankers on the twigs should be discarded in order to prevent the introduction of the disease in the new orchard. As a rule, nurserymen take all possible precautions to keep their stock clean. The use of budwood from young, vigorous, clean trees is especially important. (2) The more vigorous the growth of the tree, the more resistant it is to this disease. Therefore, good growing conditions by cultivation and fertilization should be maintained. Nitrogenous fertilizers are especially helpful. (3) Spraying with zinc sulphate (4 pounds zinc sulphate, 3 pounds hydrated lime, 50 gallons of water) gives a certain degree of control.

Recent reports from Arkansas and Illinois indicate that after-harvest sprays (late summer to early fall) with copper sulphate without lime were successful in eradicating the bacteria in the cankers and thus preventing infection in the spring. The copper sulphate was first used in a rather concentrated form (4 pounds in 100 gallons of water), applied about the middle of October. This was effective, but caused some injury. Later, 3 split applications were made with a weak solution of copper sulphate (1 pound in 100 gallons) at 2-week intervals, beginning about the middle of August. This resulted in good control without injury to the tree. The copper sulphate spray seems to be the most promising control measure as yet tried against this disease. However, since it has not been tested under Louisiana conditions, it is felt that it is not safe to recommend it at this time.

Leaf Curl

Description. This disease, which is one of the most serious diseases of the peach in most parts of the world, occurs only rarely in Louisiana, and it is of decidedly minor importance. It is due to a fungus *(Taphrina deformans)* which causes the young leaves to become thickened, twisted, curled, and distorted (Fig. 58). The thickened portions of the leaf are pinkish with a whitish surface. Affected leaves fall off, resulting in defoliation of the tree. The fruit and tender twigs may also be affected.

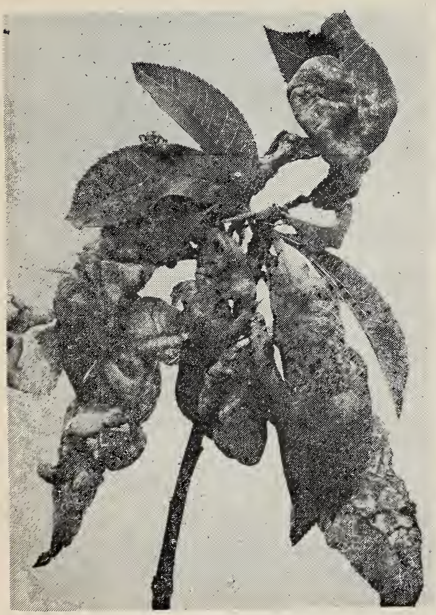

Fig. 58. Peach leaves affected with leaf curl.

Control. Since leaf curl occurs only rarely in Louisiana, and when it does occur the infection is usually not severe enough to cause much damage, control measures are probably not justified. However, this disease can be controlled very easily by one application of a suitable fungicide, such as 4-4-50 Bordeaux or lime-sulphur, during the dormant season (December-January). In the spray schedule (page 93) a combination of Bordeaux mixture and oil emulsion is recommended as a dormant spray for scales and leaf curl.

Plum Pockets

Description. Two other species of the same genus of fungus which causes leaf curl on peach cause the well-known plum "pockets" or "bladders" on plum. One of these *(Taphrina communis)* affects the young plum fruits, causing them to enlarge and become spongy and hollow, bladder-like. The other species *(Taphrina mirabilis)* affects primarily the young leaf buds and the tips of the young twigs, distorting them and producing fleshy, spongy, hollow overgrowths. This is especially bad on the Chickasaw plum and its relatives.

Control. No completely satisfactory control is known for this disease. The sprays recommended in the spray schedule against other diseases will control this disease to some extent, but not completely.

Brown Rot

(Sclerotinia fructicola)

Description. Brown rot is by far the most important disease of peaches and plums in Louisiana. It affects the blossoms in the spring, causing blossom blight. It causes cankers on twigs and branches, and causes rot of the fruit on the tree and in storage. The fruit rot phase is the most serious and most destructive. It may affect the fruit in various stages of its development, but it is most prevalent as the fruit approaches maturity. On the fruit the rot starts as small, circular, soft, brown spots which enlarge very rapidly so that in a very short time the entire fruit is rotted. The spots usually start at points where the fruit skin has been broken in some way, such as by worms, rubbing, hail, bruising, etc. The surface of the rotted part of the fruit becomes covered with a brown to gray mass of fungus spores (Fig. 56, B). After the fruit has rotted, it dries up, shrinks, and forms a dry, hard, shriveled "mummy."

Control. The brown rot fungus is carried over from one season to the next, (1) in cankers on twigs and branches, (2) on fruit "mummies" which may remain hanging on the trees, and (3) in fruit "mummies" which fall to the ground. With these facts in mind, it is easy to understand the control measures recommended for this disease.

1. Sanitation. Sanitary measures are very important because they eliminate much of the primary source of infection. All dead wood should be pruned out during the winter. All fruit that falls to the ground should be collected and either buried deep, burned, or fed to hogs. Hogs make a very clean job of picking up fallen fruit, and where the trees are conveniently located so that hogs can be turned loose under them, this is the most efficient and cheapest method of cleaning up.

2. Spraying or Dusting. Although sanitary measures are of great value, particularly in the home orchard where adequate spraying equipment is usually not available, the most satisfactory control of brown rot is by means of fungicidal sprays or dusts. (See Spray Schedule, page 93.)

Rust

(Tranzschelia discolor)

Description. This disease forms reddish pustules on the under side of the leaves and on the fruit. The upper side of rusted leaves show yellowish spots and affected foliage sheds prematurely. The premature defoliation, when it occurs year after year, has a decided weakening effect on the tree.

Control. The sulphur sprays recommended for brown rot control (see Spray Schedule, page 93) will also control the rust until harvest time. One postharvest application of wettable sulphur will normally keep the trees free of rust for the rest of the summer.

Root Knot

(*Meloidogyne* spp.)

Peach is very susceptible to root knot and is injured severely if planted in nematode-infested soil, especially if the soil is sandy. Two distinct species of root knot nematodes are involved, *Meloidogyne incognita* var. *acrita* and *M. javanica.*

Control. Peaches should not be planted on soils known to be infested with nematodes. Planting an orchard is a costly undertaking that should not be gone into blindly. Before planting ask the aid of the nematologist of the Agricultural Experiment Station. He can determine whether or not your soil is infested and can advise you on the practicability of using a soil fumigant before planting.

Nematode-susceptible cover crops, such as Alyce clover, should not be planted in a peach orchard.

Some nematode-resistant rootstocks of oriental origin are available. The most promising ones are Shalil, Yunnan, and Bokhara. These are compatible with most of the peach varieties grown in the State. Unfortunately, these are resistant to only one of the two species of root knot nematodes that attack peaches. They are resistant to *M. incognita* var. *acrita*, but not to *M. javanica.*

Some recent work with soil fumigants has shown that "Nemagon," a new nematocide (see page 124) injected into the soil around young peach trees, will kill the nematodes in the roots without damaging the tree. This is a costly control practice, probably economically impractical for treating large trees, but it may be of practical value in the case of young trees.

Black Knot

Description. This disease is striking in appearance and easily recognized by the large, black, warty swellings or knots on branches of the plum tree (Fig. 59). Peach is not affected. It is caused by a fungus *(Dibotryon morbosum)* which invades the woody parts of the tree.

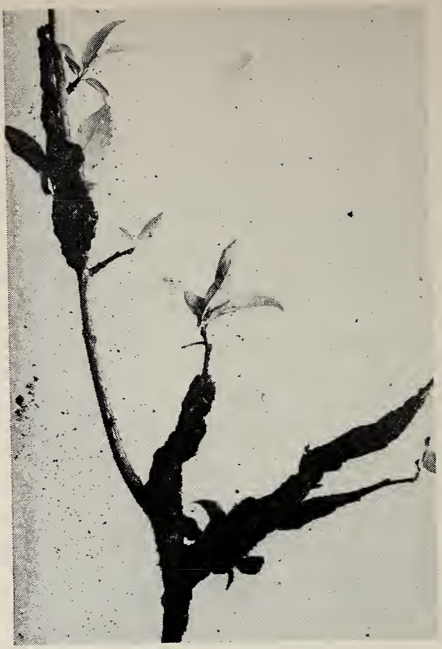

Fig. 59. Black knot on plum.

Control. Prune out during the fall and winter all diseased branches and burn. The cut should be made several inches below the knot so as to remove that part of the fungus which is growing inside the tissue beyond the limits of the knot. Spraying (see Spray Schedule, page 93) also helps to prevent new infections from getting started.

Crown Gall

(Agrobacterium tumefaciens)

Crown gall is another disease caused by bacteria (see page 4). It is characterized by the formation of large, spherical or irregular, rough galls, usually on the crown and larger roots of the tree, although, not infrequently, the galls may form on the aerial parts, on the trunk, and on the branches. Crown gall affects a very large number of different plants, both woody and herbaceous.

Control. Trees are injured by crown gall more if they become infected when young (in the nursery or soon after planting). Therefore, all nursery stock should be carefully examined before planting and any trees showing galls should be destroyed. Since crown gall bacteria can survive in the soil for many years, young trees should not be planted in soil from which old, diseased trees have been removed.

Root and Foot Rot

Oak root fungus, *Clitocybe tabescens*, (See description under Pear, page 100.)

Spray Schedules for Peaches and Plums[1]

(Read carefully the explanatory notes at the end of the spray schedules before you mix and apply the spray materials.)

Name and Time of Spray	To Control	Materials and Amounts to Use		
1. Dormant; after leaves are shed	Scales	Oil emulsion, 3% actual oil in diluted spray (See Note 4)		
and before buds swell	Scales Leaf curl	Bordeaux mixture (4-4-50, plus 3% oil emulsion) (See Note 1)		
2. Petal-fall; when 75% of petals have fallen	Curculio Brown rot Plant bugs	To make different amounts of spray use as follows:		
		Water	100 Gals.	25 Gals.
		Lead arsenate	3 lbs.	12 ozs.
		Zinc sulphate	4 lbs.	1 lb.
		Hydrated lime	8 lbs.	2 lbs.
		Wettable sulfur	6 lbs.	1½ lbs.
		50% wettable DDT (See Note 2)	2 lbs.	½ lb.
3. Shuck-fall or first cover; when 75% of shucks are off	Curculio Brown rot	Same as No. 2 (Petal-fall) except omit the DDT		
4. Second cover; 2 weeks after shuck-fall spray	Curculio Brown rot Scab	Same as No. 3 (Shuck-fall spray)		
5. Third cover; 2 weeks after second cover spray	Curculio Brown rot	Same as No. 3		
6. Fourth cover; 4 weeks before harvest	Curculio Brown rot Scab Oriental fruitmoth	Same as No. 2		
7. Pre-harvest; 7 to 10 days before harvest	Brown rot	Wettable sulphur	6 lbs.	1½ lbs.

Notes pertaining to the above schedule, on page 94.

[1] This program is based on Louisiana Agricultural Extension Service Leaflet No. 9, compiled by C. E. Smith, L. D. Newsom, and J. R. Roussel, Entomologists, Louisiana Agricultural Experiment Station, and Donald H. Spurlock, Associate Horticulturist, and K. L. Cockerham, Entomologist, Louisiana Agricultural Extension Service.

Note 1. Bordeaux mixture is first made and then the required amount of oil emulsion is added.

Note 2. If plant bugs are not a problem, that is, no cat-facing or ill-shaped fruits occur in the orchard, the DDT can be omitted. On the other hand, if this trouble is extremely bad in the orchard, follow the petal-fall spray in about 5 days with an application of 5% DDT dust.

Note 3. MIXING DIRECTIONS. (1) Place about one-half of the amount of water to be used in the tank; (2) dissolve the zinc sulphate in a small amount of water and pour into the tank; (3) add lime and agitate thoroughly; (4) add the wettable sulphur and lead arsenate and agitate until thoroughly mixed, and (5) add water to make the desired amount of finished spray.

Note 4. The following table shows amounts of different oil concentrates to use in making 3% oil spray.

	Parts Required to Make	
Materials	**100 Gals.**	**25 Gals.**
66⅔% Emulsion	4½ gals.	1 gal. and 1 pt.
Water	95 gals.	23 gals. and 7 pts.
75% Emulsion	4 gals.	1 gal.
Water	96 gals.	24 gals.
83% Emulsion	3¾ gals.	7½ pts.
Water	96¼ gals.	24 gals. and ½ pt.
97% Emulsion	3 gals.	3 qts.
Water	97 gals.	24 gals. and 1 qt.

Alternate Parathion Schedule

Name and Time of Spray	Materials per 100 Gallons	To Control	Remarks
Blossom	Liquid lime-sulfur (32 degrees Baume) 1 gal., or wettable sulfur (sulfur 80% or more) 6 lbs.	Blossom blight caused by the brown rot fungus	Sulphur sprays during bloom may aid in reducing blossom blight. The blossoms must be kept covered with sulphur during the entire period of bloom for control. This will usually make necessary several applications to reduce brown rot at harvest. Wettable sulfurs with less than 80% sulfur may be used at rates to give at least 5 lbs. of actual sulfur in 100 gals. of spray.
Petal-fall After all petals are off and before peach is showing	Wettable sulfur 6 lbs. Parathion (15%) 2 lbs.	Plum curculio Brown rot	Thorough spraying absolutely necessary if good control is expected.
Shuck-fall or **First Cover** ¾ shucks off	Wettable sulfur 6 lbs., plus Parathion (15%) 2 lbs.	Plum curculio Brown rot Scab	Spray thoroughly trunks and larger limbs in addition to spraying tops of trees in each cover spray to aid in control of peach tree borers.
Second Cover 7-10 days later	Wettable sulfur 6 lbs., plus Parathion (15%) 2 lbs.	Plum curculio Brown rot Scab	These cover sprays are all important for the control of scab, curculio and brown rot.
Third Cover 12-14 days after second cover.	Wettable sulfur 6 lbs., plus Parathion (15%) 2 lbs.	Plum curculio Brown rot Scab	Use Parathion only where curculios are present.
Five Weeks Before Harvest, of each variety	Wettable sulfur 6 lbs., plus Parathion (15%) 2 lbs.	Oriental fruit moth Plum curculio Brown rot	
Three Weeks Before Harvest, of each variety	Wettable sulfur 6 lbs., plus Parathion (15%) 2 lbs.	Oriental fruit moth Plum curculio Brown rot	
Pre-Harvest One week before harvest of each variety	Wettable sulfur 6 lbs., or liquid lime-sulfur 2 to 3 qts. or Dusting sulfur (80% or more actual sulfur)	Brown rot	Additional sulfur, preferably as dusts, should be applied before and during harvest if brown rot is present or rainy, humid weather occurs. Under certain conditions liquid lime-sulfur may cause injury, particularly to the leaves.

CAUTION: Parathion is an extremely toxic and hazardous material It is poisonous if swallowed, inhaled, or absorbed through the skin. When handling or spraying with parathion, use an approved respirator. Do not spill material on clothing or skin. Change clothes and bathe in warm soapy water after handling.

The foregoing spray schedules are designed to control the principal insect pests and diseases which affect peaches and plums in Louisiana, San Jose scale, West Indian peach scale, plum curculio, oriental fruit moth, plant bugs, scab, and brown rot. For a description of the various insect pests of peaches and plums, and for directions for controlling peach borers, write to Louisiana Agricultural Extension Service for "Insect Pest Control Leaflet No. 9."

Dusting Instead of Spraying. For the small home orchard, where a spray machine is not available and where a duster (usually a small cotton duster) is available, it may be advisable to dust instead of spray for the control of curculio, scab and brown rot. Dusts are not so effective as sprays because they do not adhere to the foliage well and are washed off by rains. For this reason it is better to spray whenever possible. If facilities for spraying are not available, dusting is the second best thing to do. Use the following dusts: (1) When about ¾ of the petals have fallen—5 parts of arsenate of lead and 95 parts hydrated lime. (2) About 10 days later—same as in (1). (3) Two weeks after the second application—80 parts of dusting sulphur, 5 parts of lead arsenate, and 15 parts of hydrated lime. (4) Three weeks after the third application—same as for (3). For best results, apply the dust either early in the morning when the air is still, or late in the evening.

PEAR

Fire Blight

Fire blight, which is caused by bacteria *(Erwinia amylovora)* is by far the most serious disease of pears and apples. It is because of the blight that the most desirable varieties of eating pears, such as the Bartlett, which is very susceptible, cannot be grown successfully in the State.

Symptoms. Blight is most conspicuous during blooming time. The blossoms and the leaves next to them turn black. The tips of twigs and branches die back, and the killed leaves which are dark brown to black in color remain hanging (Fig. 60). Bark cankers of various sizes form on branches and stems, or even on the main trunk of tree.

Control. Under the warm, humid conditions of our state, control of fire blight is very difficult. In regions with drier climate the blight can be kept in check by removing and burning the blighted twigs and by scraping the cankers on the branches and painting the wounds. This practice has been tried in Louisiana and has not proved effective. Furthermore, blight affects other related plants such as apple, crab-apple, loquat (Japanese plum), pyracantha, etc., and the bacteria are spread by insects, especially bees, over long distances. For Louisiana conditions, the following recommendations will be found helpful.

1. *Resistant Varieties.* Pear varieties possess varying degrees of resistance to fire blight. Unfor-

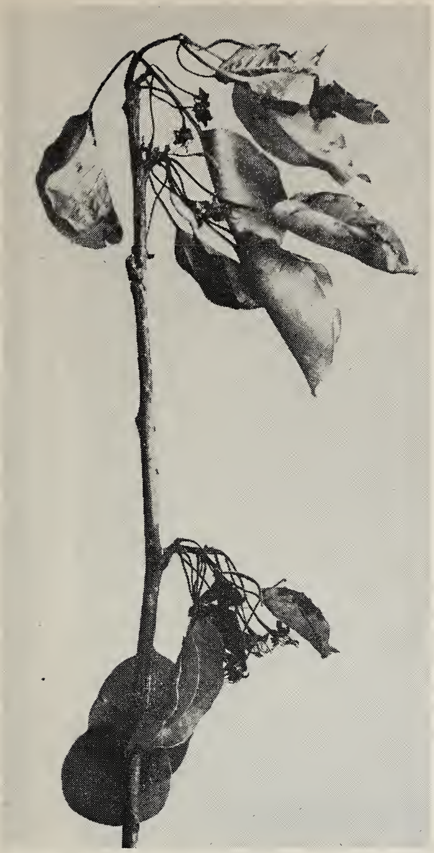

Fig. 60. Fire blight on pear. Note that the blighted leaves and blossoms turn black and remain hanging on the twig.

tunately most of the high quality eating pears, such as Bartlett, are very susceptible. Of the many varieties that show some resistance to blight, Pineapple and Richard Peters are the most resistant. The Pineapple, unfortunately, is a poor quality pear. Its fruit is satisfactory for cooking and preserving but not for eating fresh. The Richard Peters is a good quality pear, but it has the weakness of being self-sterile. It will not set fruit if planted by itself. The varieties Bosc, Seckel, Lincoln, and Douglas are good pollinators for Richard Peters, but, of these, only the Douglas is blight-resistant. If the Richard Peters is selected for planting, at least one Douglas tree should be planted close by to act as pollinator. The Pineapple is self-fertile and will set fruit if planted alone. Both Pineapple and Richard Peters are very susceptible to the Early Leaf Spot. (See page 98.)

Other varieties that are more or less resistant to blight are: Ayres, Baldwin, Carnes, Dabney, Douglas, Garber, Hood, Hoskins, Kieffer, LeConte, Maxine, Mooers, Old Home, and Orient. It must be understood that these varieties are not blight-proof. They possess sufficient resistance so that they are not killed by the blight, but, when wet weather prevails during the period of blooming, some of these may blight badly.

The Hood has fruit of fair quality, better than that of the Pineapple. It is an early bloomer, and its blossoms are often killed by frost. The Kieffer has the advantage of being resistant to the Early Leaf Spot.

2. Sprays. A weak Bordeaux mixture (2 pounds bluestone, 2 pounds hydrated lime, 100 gallons water), applied when the trees are in full bloom, reduces blight infection but does not prevent it completely.

In recent years, sprays or dusts of antibiotics (streptomycin, agrimycin) have been tried in some northern and western states. The use of antibiotics for blight control is still in the experimental stage, and is not recommended at this time. While antibiotics appear to be very effective, their high cost (the price will probably come down eventually) makes their use economically impractical, for the home orchard at least, although they probably have a place in commercial orchards of high-quality pears. One commercial preparation of antibiotic spray is available on the market under the trade name of "ORTHO Streptomycin Spray."

3. Cultural Practices. The blight bacteria thrive on tender, succulent growth. For this reason the more vigorous the tree, the worse it will blight. Therefore, it is advisable not to over-fertilize, not to prune heavily, and not to cultivate the trees. This applies to both pears and apples.

Leaf Spots

Two leaf-spotting diseases, caused by two different fungi, occur commonly on pear. For convenience, these are termed here the "Early Leaf Spot" and the "Late Leaf Spot" and are discussed separately.

Early Leaf Spot

(Fabraea maculata)

The early leaf spot disease makes its appearance early in the spring, usually in April. The spots on the leaves are mostly circular in outline, dark-brown to nearly black in color, with purplish margins (Fig. 61, A). Spotted leaves turn yellow and shed. Defoliation usually starts on the lower branches and progresses upward. As new leaves are produced on the defoliated branches, they in turn become infected and fall off. Thus the defoliation continues throughout the summer. It is common for the defoliated trees to bloom profusely in late summer

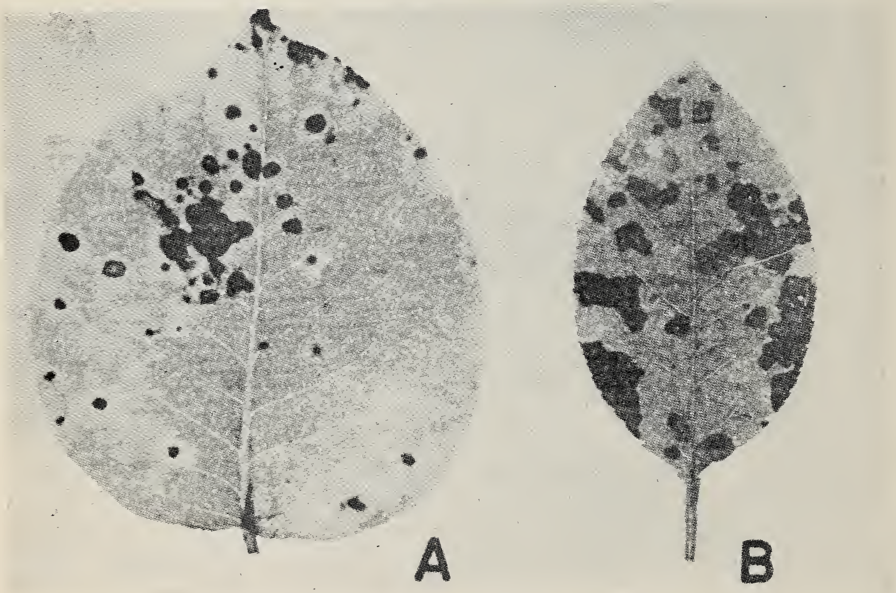

Fig. 61. Leaf spots of pear. (A) Early leaf spot (Fabraea maculata). (B) Late leaf spot (Cercospora minima).

or early fall, and to bloom only sparingly and set very little fruit the following spring. In some varieties (as the Garber for example) the disease affects the fruit also, causing black cankers and cracks on it.

Control. The early leaf spot fungus has many ways of overwintering. It produces two kinds of spores on the dead leaves on the ground. It also forms minute cankers on the bark of twigs and shoots from which spores arise in the spring. In Louisiana the first method of overwintering of the fungus is the most common. Infection in the spring starts from spores produced on dead leaves on the ground. With these facts in mind, the following recommendations are made for the control of this disease:

1. Remove the dead leaves from under the trees in the winter, either by plowing them under or, better still, by raking and burning. This will eliminate the main source of infection.

2. Spray with Ferbam (Fermate), 2 pounds in 100 gallons of water. Two spray applications, one in April, just as soon as spots are beginning to appear on the foliage, and a second one about three weeks later should prove sufficient, but if the disease is not checked, a third application about three weeks after the second, is advisable. Other organic fungicides, such as Zineb (Parzate, Z-78), or Captan, will probably be effective, but they have not been tested in Louisiana. Copper fungicides (Bordeaux mixture, Tribasic Copper Sulphate, C.O.C.S., etc.) are effective against the disease but sometimes cause injury (burning of the foliage and russeting of the fruit).

Late Leaf Spot

The late leaf spot disease is caused by another fungus *(Cercospora minima).* This disease makes its appearance late, usually in August. The spots are angular to indefinite in outline and brown to grayish in color (Fig. 61, B). When many spots develop, the leaves turn yellow and shed, so this disease also causes defoliation.

Control. Since this disease appears late in the season, after the crop is over, it does not usually cause enough damage to justify control measures. However, if the infection is severe, or if it starts earlier than usual (under favorable conditions it may start in July), and it is found necessary to control it, the same kind of sprays recommended for the early leaf spot will be found effective.

Root and Foot Rot

(Clitocybe tabescens)

During the summer (especially in late summer) pear trees are often seen with yellowish, unhealthy, wilting foliage. Such trees usually die before the end of the summer. Examination of trees thus affected will show that the bark of the trunk near the ground line and that of the crown and main roots is dead (Fig. 62). A creamy-white, matted fungus growth occurs between the bark and the wood and between layers of the bark. The disease is caused by the oak-root fungus *(Clitocybe tabescens),* which attacks a very large number of woody

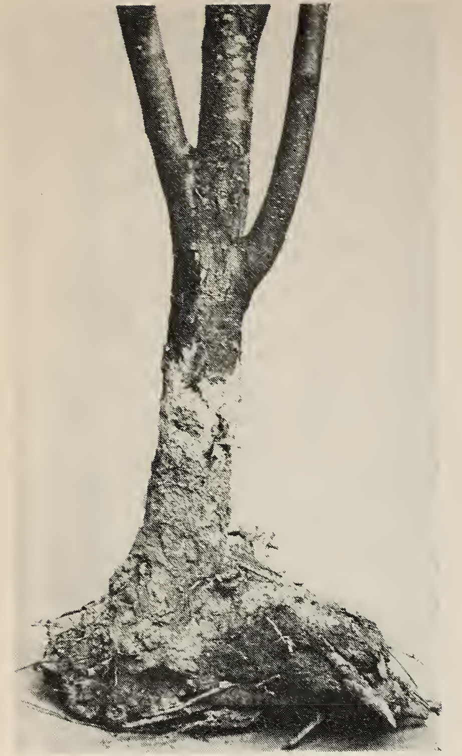

Fig. 62. Root and foot rot of pear.

plants. In Louisiana the disease has been found on pear, tung, peach, apple, weeping willow, grape, rose, photinia, and camellia. The fungus occurs naturally on the roots of various kinds of oaks, and when the land is cleared it persists for several years on roots which are left in the ground. This is the reason why foot rot is almost invariably found on trees which have been planted on recently cleared land.

Control. If the disease is discovered in time, before the bark has been killed completely around the trunk, the tree may be saved by scraping the killed part and painting the wound with Bordeaux paste. Unfortunately, by the time the tree becomes sick enough to be noticed, the trunk is usually completely ringed and then it is too late to save it. When planting on newly-cleared land, especially land occupied by oaks, an effort should be made to remove the large pieces of oak roots from the soil.

Fruit Rots

About the time pears are approaching maturity, spots which are at first brown but soon turn black, usually appear on some of the fruits. These rot spots usually start at worm holes or at places where the fruit has been injured by birds, hail, wind, etc. The rot increases rapidly so that in a short period large areas on the fruit, or even the entire fruit, rot and turn black.

Fruit rots are caused by several fungi (molds). The most common one in Louisiana is *Botryosphaeria ribes*. This fungus occurs on many woody plants in the South, causing bark cankers on many trees and shrubs.

Control. Sanitary measures offer the cheapest method of control. Dead wood should be pruned and burned. Fruit that falls to the ground should be picked and removed from the orchard. Spraying for coddling moth (see Spray Schedule) will help to control black rot because much of the infection starts in holes of coddling moth worms. Spraying the fruit about three weeks before harvest will prevent much of the black rot, but it is questionable if this is economically practicable.

Pear Spray Schedule

Spray No. and Time	Kind of Spray	For Control of
1. Dormant	Oil emulsion 2 gals. Water 50 gals.	San Jose scale, if present.
2. Full bloom	2-2-100 Bordeaux mixture	Fire blight. (Use only on varieties that blight.)
3. Calyx (¾ petals fallen)	2-2-100 Bordeaux mixture plus 3 lbs. lead arsenate	Coddling moth Fire blight Early leaf spot
4. About middle of April	Ferbam (Fermate) 2 lbs. Water 100 gals.	Early leaf spot
5. About middle of May	Same as No. 4	Early leaf spot

PECAN

The pecan is affected by a large number of diseases and insect pests. Only a few of the most common diseases are discussed here. For more complete information, write to the United States Department of Agriculture, Washington, D. C., for Farmer's Bulletin No. 1829 which contains a detailed account of all the diseases and insect pests of pecan and their control.

Scab

Description. Scab, caused by a fungus, *Cladosporium effusum,* is by far the most important pecan disease, especially in the more humid southern half of the State. In the drier, northern part of Louisiana, scab is less troublesome. Scab affects the leaves, shoots, and nuts. The spots are circular or elongated, olive-brown to black in color, raised at first

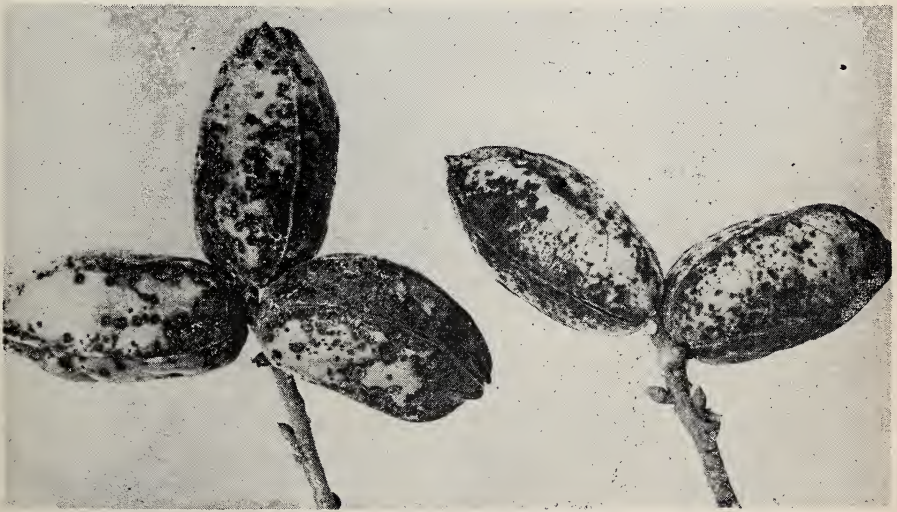

Fig. 63. Scab on pecan nuts.

but becoming sunken with age. When numerous, the spots unite to form irregular black blotches on the nut husks (Fig. 63). Badly scabbed nuts fail to fill and usually drop.

Control. Scab, as well as other diseases and insect pests of pecan, can be effectively controlled by spraying (see Spray Schedule). The commercial pecan grower knows well that he can not grow this crop successfully without spraying and he is equipped with the necessary machinery for applying insecticides and fungicides to his trees. The difficulty is with the small grower who has a limited number of trees in the home yard or small farm; he can not afford the costly machinery needed to spray large trees.

Resistant Varieties. Pecan varieties differ greatly in their susceptibility to scab. For home and small farm planting, where means for spraying large trees are not available, the planting of resistant varieties is the only practical way to avoid scab. The following varieties are among the most resistant: Stuart, Desirable, Barton, Elliot, Jennings, Curtis, Dependable.

Unfortunately, resistance to scab is not absolute and unchangeable. Many of the varieties that are resistant at present may lose their resistance in the future. This happened before. Varieties, such as Teche, Nelson, Moneymaker, and Success, that were highly scab-resistant in the past, scab badly now in some localities, particularly in the southern part of the State. Stuart was considered practically immune to scab in the past, but now it is known to scab badly in some localities. The explanation for loss of resistance is that the scab fungus changes, giving rise to new pathogenic races that are capable of parasitizing the resistant varieties.

Sanitary Measures. The scab fungus overwinters principally on husks left on the tree and on husks and leaves on the ground. If this debris is either plowed under, or raked and burned, a great deal of the early infection of the spring growth will be avoided.

Leaf Blights

Under the general heading of "leaf blights" are included several diseases which cause leaf spotting and premature defoliation. Some of these are:

1. **Downy Spot** *(Mycosphaerella caryigena)*. The symptoms are greenish-yellow, downy spots on the underside of the leaves earlier in the season, which become visible on the upper side of the leaves as brown dead spots during the latter part of the summer. Delmas, Moneymaker, Stuart, and Frotscher are among the varieties more susceptible to this disease.

2. **Leaf Blotch** *(Mycosphaerella dendroides)*. The first signs of this disease are a greenish-brown, velvety, tufted growth in spots on the underside of the leaves and faint yellow spots on the upper side. This disease makes its appearance usually in late June or early July. Later in the season the velvety growth on the underside of the spots disappears, and minute, black, pimple-like structures

appear on the affected surface. The spots enlarge and many unite to form large, irregular blotches. Severe defoliation occurs in late summer. The oldest leaves are shed first.

3. **Vein Spot** *(Gnomonia nerviseda)*. The spots occur along the veins. Those along the midrib are long in shape; those originating near a smaller vein are circular. Spots also occur on the petioles (leaf stems) and on the stems of the leaflets. Severely affected leaves are shed prematurely. The Van Deman, Frotscher, and Stuart are among the most susceptible varieties.

4. **Brown Leaf Spot** *(Cercospora fusca)*. Circular to irregular reddish-brown spots, varying in size from one-eighth to one-half inch across, characterize this disease. The older spots become grayish in color. The disease usually appears in July and older leaves are affected first. In late summer the spotting increases rapidly and the trees become badly defoliated by the first part of October. All pecan varieties are susceptible to this disease, but the Stuart and the Moneymaker are most affected. Brown leaf spot ranks next to scab in importance.

5. **Liver Spot** *(Gnomonia caryae*, var. *pecanae)*. This disease is characterized by dark brown circular spots on the lower surface of the leaves and located mainly along each side of the midrib. Later in the season the color of spots changes to cinnamon-brown. This disease is more prevalent in the northern part of the State. Like the other leaf blights, liver spot causes premature shedding of leaves if the infection is severe.

Control of Leaf Blight. Organisms causing the leaf blights are relatively weak parasites, and for this reason the blights are more prevalent and more destructive on neglected or weakened trees which have not been adequately cultivated and fertilized. Strong, vigorously-growing trees are not damaged appreciably. Proper care of the trees, adequate cultivation, and fertilization will in most cases be sufficient protection against the leaf blights. However, these diseases can also be easily controlled by spraying with Bordeaux mixture. If the trees have been sprayed for scab control, no additional spraying will be necessary. (See Spray Schedule for control of pecan diseases and insect pests, pages 104-105.)

Rosette

(Non-parasitic)

Rosette is a nutritional trouble caused by zinc deficiency. This disease is characterized by a variety of symptoms. In early stages the leaves, especially those of the top branches, show a slight yellow mottling. In more advanced stages the leaflets become narrowed and crinkled, with reddish brown spots or holes between the veins. The internodes of the new shoots become shortened so that the leaves are borne close together, forming a bunched, rosetted type of growth. In the more advanced stages the foliage, as a whole, has a bronzed or rusty appearance. In still more advanced stages, there is a dieback of the shoots. Trees that are severely rosetted usually do not bear fruit.

Spray Schedule for Pecans

(This schedule has been copied from the 1954 revision of United States Department of Agriculture Farmers' Bulletin 1829)

Name of Spray and Time of Application	Insect or Disease to be Controlled	Spray Materials (per 100 gallons)	Remarks
First prepollination spray, when buds are bursting and first leaves are showing	Scab, downy spot.	4-1-100 Bordeaux mixture	To prevent foliage injury, apply only when temperature is above 55°F.
Second prepollination spray, when first leaves are half grown	Scab, downy spot, vein spot, nursery blight	4-1-100 Bordeaux mixture	
First cover spray, when tips of small nuts have turned brown	Scab, downy spot, vein spot, leaf blotch, brown leaf spot, nursery blight	6-2-100 Bordeaux mixture or Ziram or zineb, 2 lbs.	
	Pecan nut casebearer, pecan leaf casebearer, aphids, and mites.	50 percent DDT, 2 or 3 lbs. or 15 percent parathion, 2 lbs. or Nicotine sulfate, ¾ pt. plus Summer oil 2 qts.	If pecan nut casebearer infestations are heavy, make a second application 1 week later with any of the insecticides listed. Use parathion if aphids and mites require treatment.
	Rosette	Zinc sulfate, 4 lbs. in Bordeaux mixture	Reduce zinc sulphate to 2 lbs. if Bordeaux mixture is not used.

Second cover spray, 3 to 4 weeks after first cover spray	Scab, downy spot, vein spot, leaf blotch, brown leaf spot, thread blight, nursery blight, powdery mildew	6-2-100 Bordeaux mixture or Ziram or zineb, 2 lbs.	If fall webworms or walnut caterpillars are abundant, add 50 percent DDT, 2 lbs. or 15 percent parathion, 2 lbs. or Lead arsenate, 3 lbs. per 100 gals.
	Rosette	Zinc sulfate, 4 lbs. in Bordeaux mixture	Reduce zinc sulfate to 2 lbs. if Bordeaux mixture is not used.
Third cover spray, 3 to 4 weeks after second cover spray	Scab, brown leaf spot, liver spot, thread blight, nursery blight, powdery mildew.	6-2-100 Bordeaux mixture or Ziram or zineb, 2 lbs.	
	Pecan leaf casebearer, aphids, and mites	50 percent DDT, 2 lbs. or 15 percent parathion, 2 lbs. or Lead arsenate, 3 lbs.	
	Rosette	Zinc sulfate, 4 lbs.	Reduce zinc sulfate to 2 lbs. if Bordeaux mixture is not used.
Fourth cover spray, 3 to 4 weeks after third cover spray	Scab, powdery mildew	6-2-100 Bordeaux mixture or Ziram or zineb, 2 lbs.	For best control of weevils apply combination spray when as many as six can be jarred from a tree and again in 10 days to 2 weeks. Toxaphene may be mixed with ziram or zineb, but not with Bordeaux mixture
	Pecan weevil	50 percent DDT, 6 lbs. or 40 percent toxaphene, 6 lbs.	

Parathion is deadly poison. Treat it with great respect. Follow the precautions of the manufacturer, printed on the container.

Rosette is more prevalent on alkaline or neutral soils, on soils poor in organic matter, and on badly eroded soils, but may occur on other types of soil.

Control. Rosette can be easily corrected by the use of zinc (usually in the form of zinc sulphate). Zinc sulphate may be applied in three different ways—in the soil, in holes bored in the trunk, or as a spray.

Applications of zinc sulphate to the soil at the rate of ½ to 1 pound for each year of the tree's age should be made in late winter (February or March). The chemical should be broadcast evenly under the tree, and it is well to disc it in. The soil application method has a long-lasting effect. The only drawback to this method is that with certain soil types (alkaline soils especially) it does not work. Some soils have the power of immobilizing the zinc so that the roots cannot take it up. The soil-application method works well with acid soils.

A second method is to bore holes in the trunk and insert zinc sulphate in them. Holes 7/16 of an inch in diameter and 2½ to 3 inches deep are bored at intervals of about 4 to 6 inches spirally around the trunk. A heaping teaspoonful of dry zinc sulphate is inserted in each hole, and the holes are then plugged with cork stoppers. This method should be used only where it is known that soil applications are not effective and where the trees cannot be sprayed, for boring the holes in the trunk injures the trees somewhat.

Where facilities are available for spraying, the easiest and cheapest way to control rosette is to spray with zinc sulphate at the rate of 2 to 4 pounds per 100 gallons of water. Where spraying for the control of scab or other diseases or insect pests is practiced, zinc sulphate may be mixed with the other spray materials. See Spray Schedule, page 104.

STRAWBERRY

Leaf Diseases

Leaf Spot. The leaf spot disease (which locally is called "rust") is caused by a fungus *(Mycosphaerella fragariae)* which enters the leaf and kills some of the leaf tissues. When the spots first appear they are small and purplish, but the typical mature spot has a grayish to white center with a reddish border and is about 1/8 inch in diameter. In the spring, when infection occurs on rapidly-growing tender foliage the spots are light-brown in color and have no reddish borders. In cases of severe infection the spots are so numerous that they cover the greater part of the leaf area and often kill the leaf (Fig. 64). Spots occur also on the petioles, on the fruit stalks, on the calyces, and occasionally on the green berries. On susceptible varieties, like the Klondike, leaf spot is an extremely destructive disease. Fortunately, most of the new strawberry varieties grown in Louisiana are tolerant to leaf spot (see under control, page 108).

Leaf Scorch. The scorch is

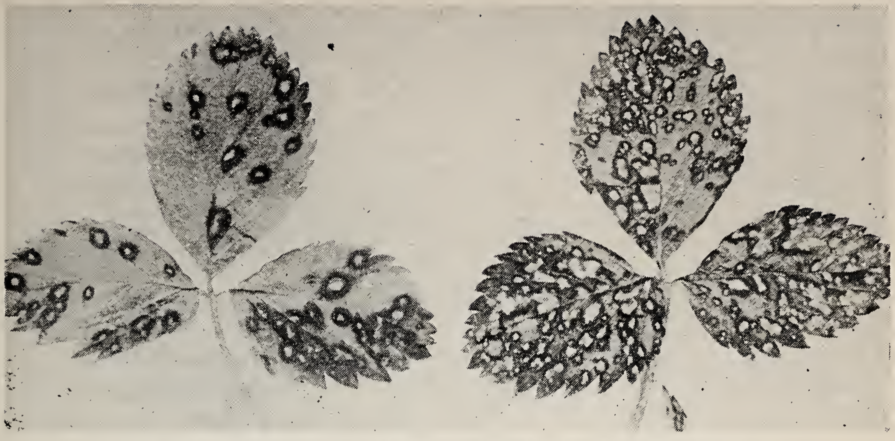

Fig. 64. Strawberry leaf spot (Mycosphaerella fragariae).

caused by another fungous parasite, *Diplocarpon earliana.* Scorch makes its appearance first as minute purplish spots on the upper surface of the leaf. The spots enlarge rather rapidly, forming angular to irregular spots or blotches (Fig. 65). The center of the scorch lesions never becomes gray or white. In this respect scorch differs from the leaf spot (rust). When infection becomes general, the leaves "scorch," that is, they dry up as if scorched by fire. The disease also occurs on the petioles, fruit stalks, and calyces. The calyces dry up, making the fruit very unattractive. The scorch is much less common than the leaf spot in Louisiana.

Purple Leaf Spot. The symptoms of this disease are almost

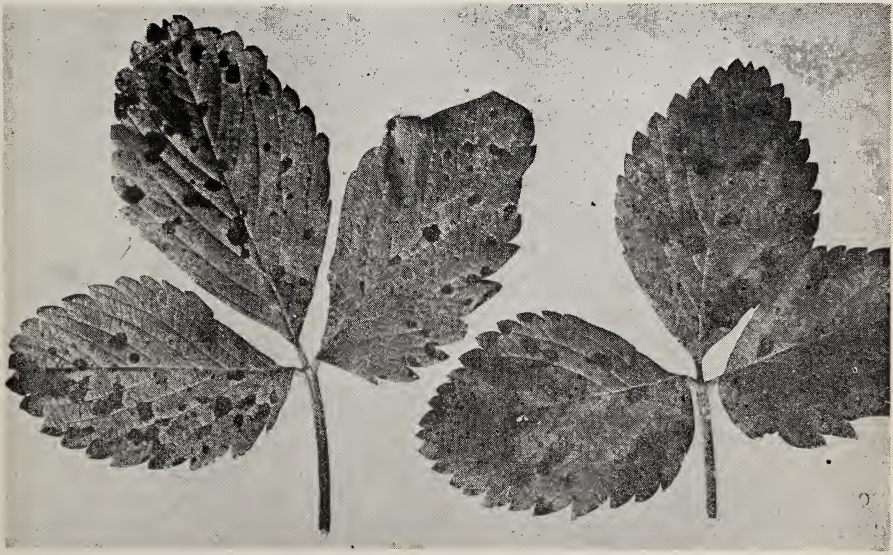

Fig. 65. Strawberry leaf scorch (Diplocarpon earliana).

identical with those of the leaf scorch, but the disease is caused by a different fungus, *Mycosphaerella louisianae.* This is of relatively small economic importance.

Angular Leaf Spot (leaf blight). The spots are large, first purplish, then brown in color, and usually, but not always, triangular in shape, their margins being delimited by the larger leaf veins. This disease, caused by the fungus *Dendrophoma obscurans,* occurs for the most part during the hot summer months when the plants are in a weakened condition. It does very little damage.

Cercospora Leaf Spot *(Cercospora* sp.). The spots are small (smaller than those of any of the other leaf diseases) and round. They are purple when young, becoming white with purplish borders when older. This disease also occurs only during the summer months and is of minor importance.

Control of Leaf Diseases. The following measures are recommended for the control of strawberry leaf diseases:

1. *Resistant Varieties.* Most of the varieties presently grown in Louisiana are resistant to the two principal leaf blights, leaf spot and scorch, and normally do not require spraying. However, they are not immune; under favorable weather conditions they may blight rather badly. The new promising selection 188, that is being released for commercial planting, apparently possesses very little resistance to leaf spots and will probably require spraying.

2. *Sprays.* All leaf blights can be controlled by the use of fungicides. Spraying, naturally, adds to the cost of production.

Bordeaux mixture, 4-4-100, is very effective. Other copper fungicides, such as "Tribasic Copper Sulphate," "Copper A," "C.O.C.S.," etc., are also effective and more convenient to use, although perhaps somewhat more costly than homemade Bordeaux. The copper content of these proprietary copper fungicides varies from about 24 per cent to 53 per cent. Those that contain 53 per copper should be used at the rate of 3 pounds in 100 gallons of water; those with 24 per cent copper at the rate of 6 pounds in 100 gallons.

Some of the organic fungicides, such as Captan and Zineb, also appear to be very effective against the leaf blights, but these have not been tested sufficiently in Louisiana. In a limited number of tests, Captan proved superior to other organics. The organics are more costly than the copper fungicides, particularly homemade Bordeaux, and no information is available at present on whether or not they are sufficiently more effective than the copper fungicides to justify the extra cost. If Captan is used, it should be used at the rate of 4 pounds per acre. That is, 4 pounds should be added to enough water (probably about 100 gallons) to spray one acre.

Regardless of the fungicides used, it is recommended that spraying should begin in the latter part of January or early in February and continue, at approximately 10-day intervals, until the fruit begins to ripen. If Captan is used, the spraying may be continued during harvesting. (See under fruit rots, page 111.)

3. *Sanitation.* Since the two main leaf blights, the leaf spot and the leaf scorch, do not spread very rapidly during the hot summer months, these can be almost completely eliminated from the plant bed by sanitary measures. In early June the plants that have been selected for plant production should be gone over carefully and all the old, spotted leaves should be removed and burned. This procedure should be repeated once or twice during the summer. This method of obtaining clean plants is especially effective with isolated small patches in home gardens.

Crown Rots

Two common soil-inhabiting fungi are responsible for a disease known as crown rot which, under certain conditions, may result in serious losses. These fungi attack the plant at the crown. The bases of the leaves are killed and the leaves damp-off (Fig. 66). The plant may be killed outright or it may recover. Recovering plants push out a number of secondary buds below the killed crown and produce small, spindly leaves.

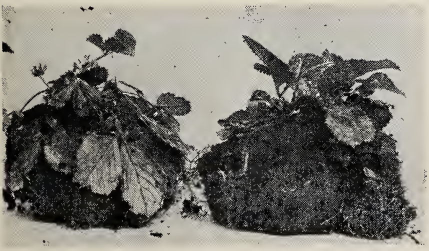

Fig. 66. Strawberry crown rot.

One of these fungi (*Sclerotinia sclerotiorum*) is a cool weather fungus, and for this reason it is active only during winter and early spring. The disease caused by this fungus is favored by prolonged cool, cloudy, rainy or foggy spells and by bushy growth of the plants.

The second fungus *(Rhizoctonia)* is active both winter and summer. In the winter, this fungus is most likely to attack plants in low spots in the field, plants that have been planted so deep that their crowns are partly covered by soil, and especially plants that have been injured by frost.

The symptoms produced by both these fungi are similar. However, in the case of the first fungus *(Sclerotinia sclerotiorum)*, numerous black, hard bodies (sclerotia) are usually found on the decaying leaves and crowns of the affected plants. These sclerotia constitute the resting stage of the fungus, and they remain inactive in the soil during the summer months.

Control. No satisfactory method of control is known.

Dwarf

The dwarf disease, which also goes by such local names as "blind plant," "wild plant," "crimp," etc., is caused by the bud nematode, *Aphelenchoides besseyi.* The nematodes occur in large numbers inside the buds and produce the injury by feeding on the young unfolded leaves.

The symptoms of dwarf are very striking (Fig. 67). The leaves are narrow, brittle, twist-

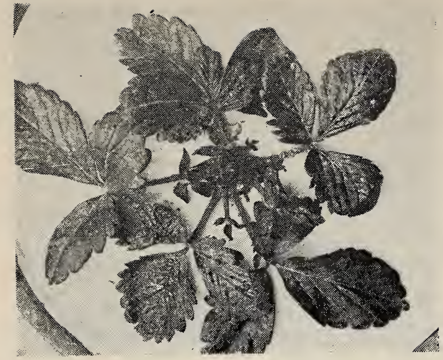

Fig. 67. Strawberry dwarf.

ed, and vary in color from somewhat bronzed to even deeper green than the healthy ones. The petioles are very short, and the young leaves are greatly reduced in size. Usually all the runner plants from a dwarf mother plant are diseased. Dwarf is a summer disease, the symptoms disappearing during late fall and winter. The reason for this is that the nematodes are inactive during the cold months.

Control. Even though dwarf is not a serious disease in Louisiana because the diseased plants recover during the winter and produce fruit in the spring, it causes injury to plants and a certain degree of reduction in yields. The disease can be easily kept in check by digging and destroying the diseased plants during the summer and early fall.

Root Knot

(Meloidogyne hapla)

Root knot is caused by another nematode. This nematode attacks the roots, causing numerous very small knots or galls and a breakdown of the roots (Fig. 68). The root injury interferes with the absorption of water and nutrients and this results in weak growth and reduced yields. The yield data presented in the accompanying table illustrate very strikingly the marked reduction in fruit production that can be caused by the root knot nematode. These data were obtained in a test at the Fruit and Truck Experiment Station at Hammond.

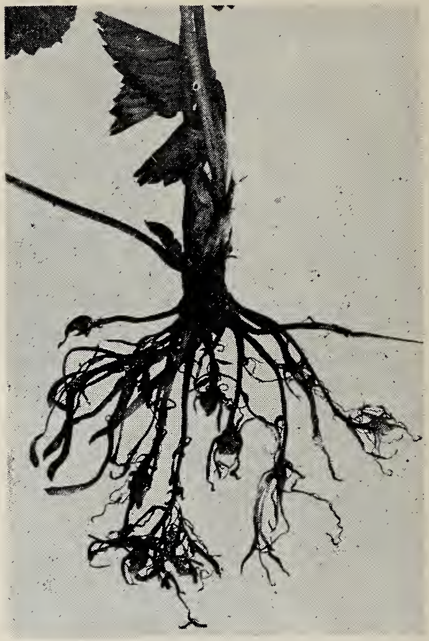

Fig. 68. Strawberry root knot.

Yields in crates per acre of clean and root knot infested plants:

Treatment	Yields
A. Klonmore plants raised on fumigated plant bed and transplanted on fumigated soil	211
B. Klonmore plants raised on fumigated plant bed and transplanted on non-fumigated soil	137
C. Klonmore plants raised on non-fumigated plant bed and transplanted on fumigated soil	140
D. Klonmore plants raised on non-fumigated plant bed and transplanted on non-fumigated soil	82

Control. Control of root knot is difficult and expensive. There are many soil fumigants available, but, in general, they are costly and somewhat difficult to apply. The cost of fumigation will run to about $15 per acre. This cost is not prohibitive if the fumigation will result in yield increases comparable to those shown in the table above, but it should be kept in mind that these figures represent only one year's results of a test on one field. We have no assurance that yield increases of this magnitude will be obtained in every case. Not every field in the strawberry-growing area is infested. A limited survey indicated that about 42 per cent of the fields tested were infested to a greater or less extent.

This problem has not been sufficiently investigated to justify a general recommendation of soil fumigation at this time. The limited studies made thus far indicate that it will be profitable to fumigate in cases in which it is known that a particular field is heavily infested with the root knot nematode. Those interested may obtain information on the kind of fumigant to use and on methods of application from the Department of Plant Pathology, Louisiana State University, Baton Rouge, or from the Fruit and Truck Experiment Station in Hammond.

Berry Rots

There are several fungi which can cause rotting of the berries in the field if conditions for their development are favorable during the picking season. Warm wet weather, especially if prolonged for several days, is very favorable for the development of berry rots. When such weather prevails during harvest the losses from fruit rots are tremendous because the rots not only destroy the berries in the field but they affect the market price of the fruit, for the rots continue to develop in transit. On the other hand, if cool dry weather prevails during the picking season, losses from rots are negligible.

The following different kinds of berry rots are the most common ones in Louisiana.

Gray Mold *(Botrytis* sp.). This is one of the most common and most destructive of berry rots. It starts as a soft brown spot, usually on the side next to the ground or where a berry touches another rotten berry, which soon enlarges and covers the entire berry. After the berry is completely rotted, it dries up and its surface becomes covered with a gray powder, the spores of the fungus.

Tan Rot *(Pezizella lythri)*. This is also a common and destructive berry rot in Louisiana during rainy weather. It starts as a tan-colored spot, often very inconspicuous. Later the rotted part of the berry becomes sunken, and it separates easily from the sound part of the berry.

Leather Rot *(Phytophthora cactorum)*. This rot is not generally common, but occasionally it assumes epidemic proportions in certain fields and causes severe losses locally. It affects both green and ripe berries. The texture of the rotted berries is tough and leathery, and the taste is bitter. This characteristic makes it easy to differentiate this from other kinds of berry rots.

Hard Rot *(Rhizoctonia* sp.). This is the least common and the least destructive of the berry rots. It affects berries that touch the ground, forming a hard, brown rot, usually with soil particles adhering to it, on one side of the berry.

Control. Berry rots are difficult to control. The fungi causing these rots are everywhere, in the soil and on dead plant parts, and when weather conditions are favorable (warm and wet) they multiply and spread very rapidly. Heavy mulching, so that the fruit will be kept high above the ground and well ventilated, helps to keep the rots down, particularly the leather and hard rots.

Since rot is caused by pathogenic fungi, fungicidal sprays or dusts would be expected to give satisfactory control. However, before the organic fungicides were developed, there was no suitable fungicide available for spraying ripe fruit. The fungicides then available were either poisonous and therefore unsafe, or they would stain the fruit, making it unmarketable. The organic fungicides are not very poisonous, and, at the recommended rate, they do not leave an objectionable residue on the fruit. Several of these have been tested both in Louisiana and in other states and some of these appear very promising. Of those tested in Louisiana, Captan has given the best control. Use Captan at the rate of 2 pounds per 100 gallons of water, and begin spraying about two weeks before picking and about once a week during the picking season. Spray thoroughly the foliage, the fruit, and the mulch. It is well to spray immediately after the day's picking because, in the process of picking the fruit, the pickers spread the spores of the rot fungi.

Caution. Spraying is expensive and adds to the cost of production. Therefore, spraying should be resorted to only when needed. Weather conditions determine whether or not rots will be bad in a particular season. If the prevailing weather during the harvest season is dry and cool, rots will not be bad enough to justify spraying. During the 1956 season, for example, there was hardly any rotting of berries, because dry and relatively cool weather prevailed during harvest.

Section III. Some Methods and Materials Used in Plant Disease Control

The plant pathologist has many different methods and many different chemicals at his disposal for the control of plant diseases. No attempt is made in this bulletin to list or describe all the methods and chemicals employed in plant disease control. Only the ones most commonly used, and particularly the ones which are applicable to the diseases of the crops treated in this bulletin, are considered.

Fungicides Used As Sprays or Dusts

The majority of materials used as sprays or dusts for controlling plant diseases fall within these three groups: (1) copper compounds, (2) sulphur and its compounds, and (3) organic fungicides.

Copper Compounds

1. **Bordeaux Mixture.** In the past, Bordeaux mixture was the universal fungicide. Although it has been displaced to a large extent by the organic fungicides in many instances, it is still one of the cheapest and most effective fungicides against many plant diseases and is still used extensively.

Bordeaux mixture is made with copper sulphate (bluestone), lime, and water. In writing the formula for Bordeaux, the amount of bluestone (in pounds) is given first, the amount of lime (in pounds) second, and the amount of water (in gallons) third. Thus, a 4-4-50 formula means 4 pounds of bluestone, 4 pounds of lime, and 50 gallons of water. Bordeaux mixture is relatively easy to make, and yet certain care is necessary in its preparation. To make 50 gallons of the standard 4-4-50 Bordeaux, the following method will be found satisfactory.

(a) Fill a 50-gallon wooden barrel about 2/3 full of water. Put 4 pounds of bluestone in a sack, or cloth bag, and suspend it in the water to dissolve. Bluestone dissolves very slowly if placed at the bottom of the barrel, but rather rapidly (20-30 minutes) if suspended near the top of the water. Never dissolve bluestone in a metal container because it corrodes metals, and it will not only ruin the container, but will change the chemical composition of the spray mixture.

(b) Place about 5 gallons of water in another container, and stir into it 4 pounds of fresh hydrated lime. Stir well to make a fine, milky suspension. Lime does not corrode metals, and so a metal container such as a galvanized iron wash tub may be used for the lime suspension.

(c) After the bluestone has dissolved, pour the lime suspension into it and stir. Add enough water to bring the volume of the mixture to the 50-gallon mark. The spray mixture is now ready to use.

Bordeaux mixture deteriorates rapidly, and for this reason should be used the same day it is made.

Although the 4-4-50 formulation (4 pounds bluestone, 4 pounds hydrated lime, 50 gallons water) of Bordeaux is the one most commonly used, other formulations are sometimes used for certain purposes. For pecan scab control, for example, a low-lime Bordeaux (2 pounds bluestone, ½ pound hydrated lime, 50 gallons water) is used, and for controlling the leaf blights of strawberry a 2-2-50 mixture is satisfactory.

2. **Bordeaux Paste.** If Bordeaux mixture is prepared in the form of a thick paste, it makes an effective, safe, and cheap dressing for painting pruning wounds and other cuts on trees. It is made as follows: Dissolve 4 pounds bluestone in 3 gallons of water, stir 8 pounds of hydrated lime in another 3 gallons of water, and mix the two together. This makes a thick paste which can be applied by means of a brush.

3. **"Fixed" or "Insoluble" Copper Compounds.** A great many copper compounds in the form of dry but wettable powders are on the market as substitutes for Bordeaux mixture. These are made by several manufacturers and sold under a variety of trade names (Cuprocide, Microgel, Copper A, Cupro-K, Tribasic, Spraycop, Basicop, C.O.C.S., to mention only a few). Chemically, these materials are, for the most part, either simple copper compounds (oxides, hydroxides), or complex copper salts (tribasic sulphates, oxychlorides, oxychloride sulphates).

Compared with homemade Bordeaux, the following advantages and disadvantages may be stated in general for the fixed compounds.

Advantages. (1) They come in powder form, usually in weighed packages, and they are easy to mix. All one has to do is put the required amount of the dust in the required amount of water, stir, and the mixture is ready to use. (2) Since these compounds contain, in general, less soluble copper than Bordeaux and no free lime, they cause less injury to the plant than Bordeaux.

Disadvantages. (1) In general, these compounds are less effective fungicides than Bordeaux. (2) They are less adhesive to foliage than Bordeaux. (3) They tend to settle in the spray tank. If the spray tank is equipped with an agitator, this point is not important, but if the sprayer does not have an agitator (as is the case with most of the small knapsack type of sprayers in use in Louisiana) the settling of the spray material is a serious drawback.

Several of these copper compounds are diluted with some inert filler, with or without the addition of insecticides, and used as dusts.

Since the percentage of copper in these different compounds varies, follow the recommendations of the manufacturer as to the amount to use in preparing a spray or a dust.

Sulphur

1. **Dusting Sulphur.** Sulphur possesses both fungicidal and insecticidal properties and is used effectively against such diseases as the powdery mildews, some rusts, brown rot of stone fruits, etc., and against red spider, rust mite, some leafhoppers, etc. The effectiveness of sulphur depends on the fineness of its particles.

Dusting sulphur should be 300 mesh or finer. Most brands of dusting sulphur meet this specification. Sulphur may cause injury on some plants, especially under hot and dry conditions. Sulphur should not be used on cucurbits (cucumber, cantaloupe, watermelon) because these plants are sulphur-sensitive and severe burning will result. Sulphur may be used on squash because this plant, although a cucurbit, is tolerant to sulphur and is not injured by it.

2. **Wettable Sulphur.** Sulphur by itself does not mix with water. However, if some wetting agent, such as glue, casein, or lime, is mixed with it, the sulphur becomes wettable and it can be used with water as a spray. Wettable sulphur is easily available on the market. Wettable sulphur has an advantage over dusting sulphur in that it adheres to the foliage and is not readily washed off by rains.

Sulphur, both dusting and wettable, is compatible with most fungicides and insecticides and can be safely used in combination sprays or dusts. It is compatible with Bordeaux mixtures and with other copper compounds and with most of the organic fungicides. It is compatible with such commonly used insecticides as calcium arsenate, lead arsenate, cryolite, rotenone, DDT, BHC, chlordane, etc. It is *not* compatible with oil. Sulphur should never be used with oil emulsion. If plants have been sprayed with oil emulsion, at least 3 weeks should elapse before sulphur can be used on these plants.

3. **Lime-sulphur.** Lime-sulphur is made by boiling together quicklime and sulphur (50 pounds quicklime, 100 pounds sulphur, 50 gallons of water). In the past, lime-sulphur was, next to Bordeaux mixture, the most important fungicide. It was also used as an insecticide, particularly against the San Jose and other scales and red spider mites. At present, lime-sulphur is hardly used anymore. As an insecticide it has been displaced by oil and several of the organic insecticides and miticides (parathion, malathion, ovotran, etc.) and as a fungicide by wettable sulphur and by some of the organic fungicides.

Organic Fungicides

Organic fungicides are relatively new. The first ones came out only about 15 years ago. Since then, hundreds of organic chemicals have been tested and found to possess fungicidal properties. Of these only a few have made the grade. Some of these have proved so effective against a variety of plant diseases that they have come into wide use and have displaced the copper and sulphur fungicides to a very large extent. The organic fungicides have certain advantages over the old copper and sulphur fungicides and this accounts for their wide popularity. They are more effective against some diseases and less injurious to plants than the old fungicides; they are less poisonous than the copper fungicides, and may therefore be used on food crops close to harvest or even during harvest; since they are effective in relatively small concentrations, they do not leave a conspicuous residue.

It is impractical to list all the organic fungicides in this bulletin. Only the ones that have found wide application in disease control, and particularly the ones that are recommended against the diseases discussed in this bulletin, are included. It will be noted that the same fungicide may have two or more trade names. This is confusing but understandable. The same fungicide is often made by several different manufacturers under a different trade name. To get around this confusion, common names have been coined for these fungicides. In the list, both the common and the trade names are given.

Some of the Common Organic Fungicides Used as Sprays or Dusts:

Common Name **Trade Name**
Captan — Captan 50-W, Orthocide 50 (Wettable)
Chloranil—Spergon
Ferbam—Fermate, Karbam Black, Ferradow, Ferberk
Maneb—Manzate, Dithane M-22
Nabam—Dithane D-14, Liquid Parzate
Thiram—Arasan, Thiram-50, Thylate
Zineb—Dithane Z-78, Parzate
Ziram—Zerlate, Zirberk, Karbam White

In using organic fungicides, follow carefully the recommendations of the manufacturer as to the amounts to use and method of mixing. These directions are printed on the container.

Organic fungicides are compatible with most insecticides and may thus be used as combination fungicide-insecticide sprays or dusts. Follow the directions of the manufacturer, printed on the container.

Organic fungicides may be mixed with a suitable diluent (clay, talc, pyrophyllite) usually at the rate of 10 pounds of fungicide to 90 pounds of diluent and used as dusts. Insecticides may be incorporated in the dust (see cucumber dusts, page 22). Many such dusts, "tomato-potato dust," "rose dust," etc., are sold in small or large packages for the home garden.

SEED TREATMENTS

Various methods have been devised for treating seed. The purpose of seed treatment is twofold, first to kill the pathogenic organisms that are carried on or in the seed, and second to protect the plant against pathogenic organisms in the soil. Damping-off of the seedlings is one of the most common and most serious diseases caused by soil-borne parasites.

The term "damping-off" is used to designate a disease of plants in the seedling stage. Two distinct phases of damping-off are recognized, namely, *pre-emergence damping-off* and *post-emergence damping-off*. In the first phase, the seed and young seedlings rot in the soil and never reach the surface; in the second phase, the stems of the young plants rot at the soil line, and the plants collapse and die suddenly. With some plants, a seed treatment is sufficient to give protection against both pre-emergence and post-emergence damping-off; with others, two treatments, a seed treatment and a soil treatment, are necessary for satisfactory control of the two phases.

It is also very important to

make clear the distinction between seed treatments designed to control damping-off, which is caused primarily by *soil-borne* parasites, and treatments designed to control *seed-borne* diseases, because the same treatments will not always control both. For example, Arasan or Semesan will give very effective control of damping-off of crucifer (cabbage, cauliflower, broccoli) seedlings, but will not control black rot or blackleg because the organisms causing these diseases are borne *inside* the seed where the chemicals can not reach them. Similarly, Arasan or Cuprocide will protect pepper seed and seedlings against damping-off (a soil-borne disease) but these chemicals are not strong enough to kill the seed-borne bacteria that cause the bacterial blight of peppers.

In order to apply seed treatment intelligently and effectively, it is necessary to know if the organisms we wish to control are soil-borne or seed-borne, and, if seed-borne, whether they are carried on (externally) or inside (internally) the seed. For soil-borne, and externally seed-borne pathogens chemical treatments of the seed are effective. For internal seed infections, it is necessary to use a more drastic method of control, the hot-water treatment.

The list of chemicals used for treating seeds of various kinds is very long. No attempt is made to include all of them in this bulletin; only the ones most commonly used for treating vegetable seeds are given. These are:

1. Mercury bichloride (corrosive sublimate)
2. Organic mercurials (Semesan, New Improved Semesan Bel)
3. Formaldehyde
4. Copper oxide (Cuprocide, Metrox, Curedamp)
5. Chloranil (Spergon)
6. Thiram (Arasan, Arasan-50, Arasan 75)
7. Dichlone (Phygon Seed Protectant)
8. Captan (Captan 50-W, Orthocide 75)

With these preliminary remarks in mind, we can proceed to list and discuss some of the most common methods of treating vegetable seeds for the control of seed-borne and soil-borne diseases.

1. Mercury Bichloride

(Corrosive Sublimate)

This chemical is most commonly used in the concentration of 1 part to 1,000 parts of water. Unless a large volume is required, it is most convenient to buy corrosive sublimate in the tablet form (it can be purchased at any drug store). One tablet dissolved in 1 pint of water makes a 1-1,000 solution. For larger volumes of solution, use 8 tablets to 1 gallon or 60 tablets (1 ounce) to 7½ gallons.

CAUTION. Mercury bichloride is a deadly poison and great care should be used in handling it and in disposing of it after it is used. It should be kept away from children and farm animals. Also, the chemical is corrosive to metals and it should never be dissolved in, or placed in, a metal container. Use wooden, glass, enamel, or earthenware containers. Seed *(particularly potato or sweet potato) treated with bichloride should not be used for food or feed.*

Pepper. For control of bacterial spot (see page 36), soak the seed in a 1:1,000 solution for 5 to 6 minutes. Wash thoroughly in running water, or in several changes of water if no running water is available, and spread out to dry.

NOTE. Seed dealers often treat pepper seed with some dust fungicide such as Cuprocide or Arasan. This treatment is for preventing damping-off, but will not control bacterial spot. Therefore, such seed should first be given the mercury bichloride soak, washed, dried, then treated again, either with Arasan (treatment 3) or with Cuprocide (treatment 4).

Irish Potato. For Louisiana conditions the hot formaldehyde method (page 120) is recommended for treating seed potato tubers. In some areas of the country, mercury bichloride is used for treating seed potatoes. The following two methods are used:

(a) Cold mercury bichloride, 1-1,000. Soak tubers (uncut) for 1½ hours. Plant immediately, or dry and store.

(b) Acid-mercury bichloride (6 ounces to 25 gallons of water plus 1 quart of commercial hydrochloric acid). Dip seed for 5 minutes, plant immediately, or dry and store. Do not store while wet. Twenty-five gallons of the solution will treat effectively about 40 bushels of potatoes, after which a new solution should be prepared.

Sweet Potato. Use 1-1,000 solution. Soak the potatoes for 8 to 10 minutes, then bed without washing. This treatment kills the spores of the black rot fungus (and of other pathogens) on the surface of the potatoes, and thus it helps to keep the disease in check. It does not kill the infection inside the potato, and so it does not provide complete protection against the black rot.

The seed certification service of the State Department of Agriculture requires that, for the production of certified sweet potato seed or plants, the potatoes be treated with mercury bichloride before bedding.

2. Organic Mercury Compounds

There is a long list of organic mercury compounds, sold under different trade names, which are used for disinfecting various kinds of seed. Two of these, "Semesan" and "New Improved Semesan Bel" are the ones most commonly used for treating vegetable seeds.

Semesan. This chemical may be used either as a dust to coat the seed, or in the liquid form in which the seeds are soaked.

(1) Dust. Semesan dust at the rate of ½ level teaspoonful per pound of seed may be used for the following: beet, broccoli, brussels sprouts, cabbage, cauliflower, collard, carrot, cucumber, cantaloupe, eggplant, mustard, pea, radish, spinach, squash, Swiss chard, turnip, and watermelon.

For onion, parsley, and tomato, use the dust at the rate of ¼ level teaspoonful per pound of seed.

Place the seed and the dust in a tight container and shake well until the seeds are thoroughly coated. Screen off the excess dust. Plant immediately, or store in a dry place.

Under certain conditions (planting in dry soil, for example) Semesan may cause injury to the treated seed. Therefore, for such seeds as tomato, pepper, eggplant, beet, carrot, pea, spinach, etc., which are copper-tolerant, the copper oxide treatment (page 119) should be used in preference to Semesan.

(2) Liquid Form. Soak the seed in a solution made by stirring 1 ounce of Semesan in 3 gallons of water (1 level tablespoon in 1 gallon of water). The time of soaking varies from 15 minutes to 1½ hours, depending on the kind of seed to be treated. Follow the directions on the container.

New Improved Semesan Bel. In some parts of the country this chemical is used instead of the hot formaldehyde for treating seed potatoes, even though it is not perhaps so effective as the hot formaldehyde. For Louisiana, the hot formaldehyde method (page 120) is recommended for treating seed potatoes. However, if one buys seed that has not been treated with hot formaldehyde, one can treat it with New Improved Semesan Bel. The method is easy and cheap.

Directions. Mix 1 pound of the powder with 7½ gallons of water. Dip (do not soak) the uncut potatoes in this solution, drain, cut, and plant immediately.

CAUTION. The organic mercury compounds are very poisonous and should be handled with care. In treating seed with the dust it is preferable to work outdoors and to avoid breathing the dust. Treated seed should be kept away from farm animals. Treated potatoes should not be used for food or feed.

3. Thiram *(Arasan)*

This organic fungicide is a safe and effective material for treating all kinds of vegetable seeds for preventing damping-off. It is recommended at the rate of about 1 teaspoonful per pound of seed. Actually, in treating small quantities of seed, it is not important to measure the fungicide any too accurately. Place the seed in a small jar, add enough of the dust to coat the seed well, shake for about 1 minute, and if necessary screen off the excess dust.

4. Cuprous Oxide *(Cuprocide)*

This is one of the most effective materials for treating vegetable seeds, particularly pepper, tomato, eggplant, spinach, and beet.

Directions. Place the seed to be treated in a tight container, add the Cuprocide powder at the rate of 1½ level teaspoonfuls per pound of small seed (such as tomato, pepper, eggplant) and ½ teaspoonful per pound of large seed (such as pea), shake well until all seeds are thoroughly coated, then screen off the excess powder. Treated seed may be planted immediately, or it may be stored if kept dry.

CAUTION. Seed treated with Cuprocide should not be planted in pure sand or in soil too dry for good germination, for under these conditions injury may result.

Seeds that are benefited by the Cuprocide treatment: beet, carrot, celery, cucumber, eggplant, muskmelon, pea, pepper, pumpkin, romaine, spinach, squash, Swiss chard, tomato, calendula, cosmos, pansy, salvia, zinnia.

For all the above-named seeds, *except eggplant,* seed treatment alone is usually sufficient to prevent both pre-emergence and post-emergence damping-off. However, if the seedlings begin to damp-off after emergence, the disease can be stopped by watering the plants once or twice with a suspension made with 1¼ ounces (6 level teaspoonfuls) of Cuprocide to one gallon of water.

In the case of eggpant, the Cuprocide treatment of the seed will control the pre-emergence phase of damping-off but will not protect the young seedlings against the post-emergence phase of the disease. For this reason, eggplant seedlings should be watered with a Cuprocide suspension in water as explained above.

5. Formaldehyde

This chemical is used in either liquid or dust form for treating seed and for disinfecting soil.

For treating seed potatoes the hot formaldehyde method is extensively used. A solution is made by mixing 1 quart of commercial formalin (40% formaldehyde) with 30 gallons of water which is kept at a temperature between 124° and 126° F. while the potatoes are being treated. The potatoes are dipped in this solution for 4 minutes, then are removed and spread out to dry. After treating every 50 bushels of potatoes, a pint of formaldehyde should be added to the tank of solution to compensate for loss of strength.

Hot Water Method for Treating Seed

The hot water treatment is a most effective method of disinfecting seed because it kills seed-borne pathogens both on and in the seed. At the same time, this method is very drastic, and unless due care is exercised in controlling the temperature of the water, in correct timing of the treatment, and in drying the treated seed, the germination of the seed may be considerably impaired. This is especially true in the case of old or weak seed. For this reason, the hot water treatment is recommended only for those seed-borne diseases against which no other effective treatment is known. For Louisiana, the hot water method is especially recommended for the control of black rot and blackleg of crucifers (cabbage, cauliflower, collard, brussels sprouts, broccoli, kale, kohlrabi, turnip), and the downy mildew of spinach.

As has been explained in the text (page 17) seed grown in the Puget Sound district or in other regions with rainless summers, as in California, is usually free of black rot and blackleg infection. Such seed need not be treated. If seed is known to have been produced in an area where black rot and blackleg occur during the growing season, or if the source of the seed is not known, it is recommended to treat it with the hot water method.

Directions. Place the seed in a loosely-woven cloth bag, which should be only about one-half full, and immerse it in hot water at a temperature of 122° F. Keep the water stirred during the operation and have extra hot water handy to add to it as it begins to cool, in order to maintain the temperature at 122° F. After the required exposure, remove the bag and plunge it in cold water to cool the seed quickly. Drain, and plant immediately, or spread the seed out to dry. Quick drying is essential.

Cabbage seed should be treated for 25-30 minutes; seeds of cauliflower, brussels sprouts, broccoli, collards, kale, kohlrabi, and turnip for 15 to 18 minutes. Spinach seed should be treated for 25 minutes.

After the seed has been treated with hot water and allowed to dry, it can be treated with the appropriate fungicide dust (Semesan, Arasan, Cuprocide) as recommended for the control of damping-off.

TABLES OF MEASURE[5]

The following tables will be found useful in preparing small amounts of fungicides and insecticides for the home garden.

I. Liquid Measures

3 teaspoons=1 tablespoon
2 tablespoons=1 fluid ounce
8 fluid ounces=1 cup
2 cups=1 pint
2 pints=1 quart
4 quarts=1 gallon

II. Approximate Quantities to Weigh 1 Ounce

Bluestone (copper sulphate) — 5 level teaspoons
Hydrated lime—3 level tablespoons
Sulphur—3 level tablespoons
Cryolite—2 level tablespoons
DDT wettable powder — 6 level tablespoons
Malathion wettable powder — 4 level tablespoons
Chlordane wettable powder — 3 level tablespoons
Nicotine (Black Leaf 40) solution—5 level teaspoons

SOIL FUMIGATION

In the past, soil fumigation was practiced in greenhouse culture and to a small extent in the field in special cases in which high-priced crops were grown on limited land. The use of soil fumigation in general farming was considered too costly to be practical. This concept has changed. Many factors have contributed to bring about this change. Extended research in nematology has brought to the fore the importance of nematodes as disease-inducing agents. New and better fumigants and improved methods and machinery for their application have been developed. These new developments have lowered the cost of application to the point at which it is practical and profitable to use soil fumigation on a large scale, even in the case of low-price crops under certain conditions. Soil fumigation certainly has a place in home gardens and small farms where enough land is not available for rotation. There are a very large number of chemicals that possess fumigant properties. Many of these are still in the testing stage. No attempt is made in this bulletin to include all the chemicals with nematocidal or fungicidal properties. Only the few chemicals that have come into practical use as soil fumigants are included. Some of these chemicals are fungicidal and bactericidal but not nematocidal. Others are nematocidal but not fungicidal or bactericidal, and still others possess nematocidal, fungicidal, and bactericidal properties. Practically all kill weed seeds, and this is of great value because it eliminates weeding in the treated beds.

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[5] These figures were taken from U.S. Department of Agriculture Home and Garden Bulletin No. 46, "Insects and Diseases of Vegetables in the Home Garden."

Common Soil Fumigants

I. Fungicidal but not Nematocidal

1. Formaldehyde (formalin)
2. Allyl alcohol

II. Nematocidal but not Fungicidal

1. "D-D" mixture or "Nemafume" (Dichloropropane-dichloropropene)
2. Ethylene dibromide
3. "Nemagon" (1, 2-dibromo-3-chloropropane)
4. "V-C 13 Nemacide"

III. Both Nematocidal and Fungicidal

1. Chloropicrin ("Larvacide." Tear gas)
2. Methyl bromide ("MC-2")
3. "Vapam" (Sodium monomethyl dithiocarbamate)

This grouping of fumigants may not be strictly correct. Some of the chemicals listed as nematocidal but not fungicidal ("D-D" and ethylene dibromide) may kill some fungi, especially at high rates of application. However, these chemicals are normally considered to be nematocides and not fungicides. Conversely, some of the chemicals listed as fungicidal but not nematocidal (formaldehyde, for example) possess some degree of nematocidal activity.

The following is a more detailed discussion of soil fumigants and methods of application.

1. Formaldehyde *(commercial formalin)*. Formalin is the oldest soil fumigant, and one of the cheapest. It is an effective fungicide that kills most pathogenic soil fungi and bacteria that cause wilts, root rots, and damping-off. It has the disadvantage that it is not effective against nematodes.

Method of Application. Prepare the soil ready for planting, pulverizing the clods as much as possible. Dilute 1 gallon of commercial formalin in 49 gallons of water and apply this dilution with a sprinkling can at the rate of ½ gallon per square foot of soil. Cover the treated soil with wet burlap sacks. After 48 hours, remove the cover to allow the gas to escape and the soil to dry. When the soil has dried sufficiently to be workable, stir it to facilitate the escape of the gas. Wait 10 to 14 days before planting.

2. Allyl Alcohol. This is one of the newest materials to be used for soil fumigation. Like formaldehyde, allyl alcohol is not effective against nematodes. It is a powerful herbicide, killing all weed seeds, thus eliminating weeding of seedbeds, and also a good fungicide. Thus far, allyl alcohol has been used extensively as a drench for tobacco seedbeds. It is used at the rate of 6 quarts diluted in 100 gallons of water and applied at the rate of 1 gallon of the dilution per square yard of soil. No cover is needed. Allow 10 to 14 days for the material to escape from the soil before planting.

3. "D-D" Mixture *("Nemafume")*. This material is one of the most widely used nematocides. It is not a fungicide at the recommended rates of application. It comes in liquid form and it is injected into the soil. Various types of injectors have been devised.

These range from large tractor-drawn rigs that can treat several acres in a day, to small hand-operated ones. For small plots, such as in home gardens a fruit jar may serve the purpose of an injector (Fig. 69).

Spade and rake the soil ready for planting, taking care to break the clods and remove trash. The soil temperature should be not lower than 40° F. and not higher than 80° F. when the chemical is applied. The soil should be in good tilth, neither too dry nor too wet. With a hoe make furrows in the prepared soil 12 inches apart and about 8 inches deep. Take a fruit jar with a metal cap and punch 2 holes on opposite edges of the lid with a No. 8 nail, one for pouring the fumigant and the other for an air hole.

Apply one pint of the fumigant for about 150 to 175 linear feet of the furrow. Rake the soil to cover the fumigant, and pack the soil lightly after covering the furrow. The packing helps to seal the gas in the soil. No cover is normally needed, but if the surface of the soil is rather dry, it is advisable to sprinkle it with water to form a tight seal and prevent the gas from escaping too fast. Wait at least two weeks before planting. Do not treat soil within about 3 feet of growing plants.

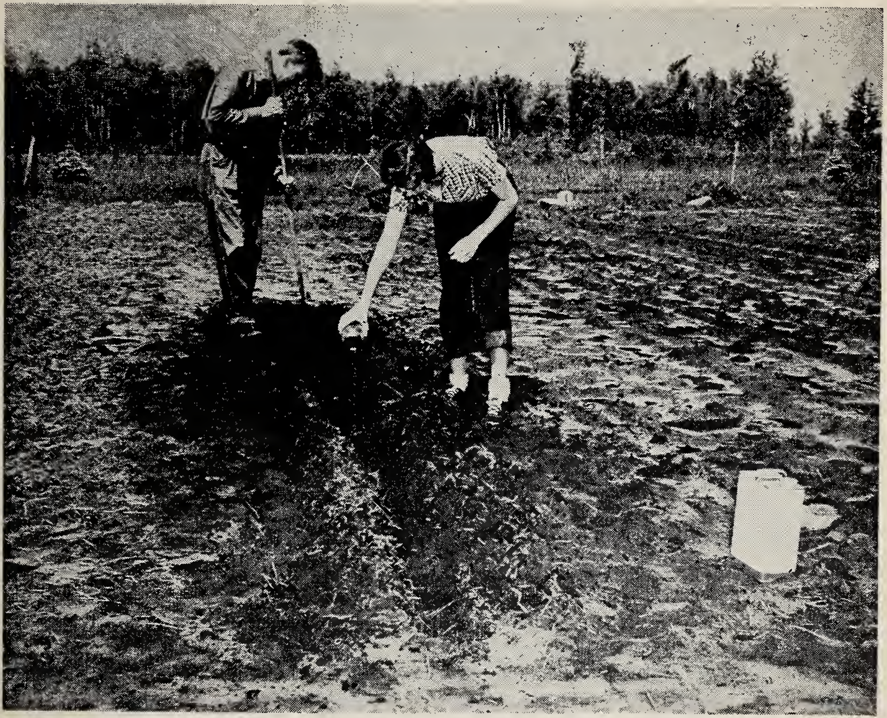

Fig. 69. The "fruit-jar" method of applying nematocides to the soil. (Photo by Dow Chemical Co.)

4. Ethylene Dibromide. This fumigant, like D-D, is a nematocide but not a fungicide. It is sold under several trade names, "Dowfume W-40," "Dowfume W-85," "Soilfume 40," "Soilfume 85." The percentage of active ingredients varies in the different formulations, so follow the directions on the container as to the amounts to use.

The method of application of ethylene dibromide is the same as for "D-D" mixture (see above).

Ethylene dibromide (and some other fumigants) is also sold in the form of capsules. This form is more costly than the liquid and perhaps impractical for large scale application, but easy and convenient to handle for the home garden. The capsules are dropped into holes in the soil, and after some time the capsule melts, releasing the gas. One difficulty with this type of application is that all the capsules may not dissolve at the same time, especially if the soil is somewhat dry. Some of the capsules may dissolve after planting, and this will result in injury or death of the plants. To get around this difficulty, it is suggested that the capsules be punctured with a sharp, heavy needle before they are dropped into the holes.

5. **"Nemagon"** *(1, 2-dibromo-3-chloropropane)*. This fumigant is sold in three formulations, as a liquid, as an emulsion, and as dry granules. The granular form can be mixed with the fertilizer and applied to the soil. This form is especially advantageous to the small farmer and home gardener.

Nemagon is an excellent nematocide but not a fungicide. Its greatest virtue is that it can be applied to the soil around living plants, and it will kill the nematodes in the roots without harming the plants. However, *not all species of plants can take this treatment; some plants are injured.* Chrysanthemum, for example, is extremely sensitive and is severely injured by Nemagon.

Before using Nemagon, be sure to read carefully the recommendations of the manufacturer, which are printed on the container, regarding dosages, methods of application, and tolerance of particular plants.

6. **"V-C13 Nemacide."** This chemical, which, like the preceding one, is a nematocide but not a fungicide, is a newcomer. We have not tested it in Louisiana and are not ready to make any recommendations. Its strongest point, according to its manufacturers, is its tenacity. It remains effective in the soil for long periods, 2 to 3 years. It acts as a *preventive* against nematode infection and not as a quick killer. It can be used around certain species of established plants without causing injury. Thus far, its use is limited to ornamental plants. *It should not be used in connection with food crops (fruits or vegetables) because its possible toxicity to humans has not been fully determined.*

7. **Chloropicrin** *("Larvacide," tear gas)*. This is a powerful soil fumigant. It kills nematodes, soil insects, fungi and bacteria, and most weed seeds. It should be the ideal soil fumigant except for the fact that it is a very disagreeable material to handle. Its fumes are very irritating to the eyes and

nose, and if the liquid is spilled on the skin it will cause burns unless it is washed off promptly. It requires special applicators to inject it into the soil; it can not be applied by simple means, such as a fruit jar, as in the case of "D-D" mixture and ethylene dibromide.

The method of application, i.e., preparation of the soil and injection of the chemical 8 inches deep, is the same as that for "D-D" mixture and ethylene dibromide, except that a special applicator is needed. After injection, the surface of the soil should be sprinkled thoroughly to form a water seal to confine the fumes. Allow 10 to 14 days for the fumes to dissipate before planting.

8. Methyl Bromide *(MC-2).* Methyl bromide is a powerful fumigant. It kills nematodes, soil insects such as grubs and wireworms, fungi, bacteria, weed seeds and Bermuda, Johnson and nut grasses. It differs from all other chemicals used for soil fumigation in the method of application. It is not injected or drenched into the soil; it is released on the surface of the soil under a gasproof cover. Application is easy and fast, once you have acquired the necessary equipment (an applicator and a gasproof cover). The applicator is inexpensive, costing probably under $2. The plastic cover is more expensive. It sells at about 3c per square foot. Thus, a cover 12′ x 15′, which is about the right size for treating an area of 200 square feet at one time, will cost around $9. However, with proper care, a cover should last 3-4 years.

Method of Application. Spade and pulverize the soil ready for planting. The soil should be in good tilth, neither too wet nor too dry, and the temperature relatively high, preferably above 60° F. Dig a trench about 6 inches deep around the area to be treated. Place some supports, such as flower pots or boards set on edge, on the surface of the soil to keep the plastic cover from lying flat on the soil surface and thus facilitate the movement of the gas. Place the loose end of the applicator plastic tube at approximately the center of the area to be treated (if large areas are to be treated, several such tubes should be used, placed not more than 30 feet apart). Place a shallow pan under the outlet of the tube so that the liquid, as it comes through the tube, will vaporize rather than sink into the soil in one spot. Now, put the plastic cover over the area, place its edges in the trench, and cover them with dirt (Fig. 70). Be sure to pack the dirt well around the edges of the plastic cover to prevent the gas from escaping. Now you are ready to release the fumigant. The fumigant comes in small pound cans. Open the applicator clamp, place the can in the ring, and press the clamp. The pressure will puncture the can, and the fumigant will flow under the cover. The can will empty in 2-3 minutes. The empty can is then removed, a new one is placed in the applicator, and the process is repeated. Use the material at the rate of 2 cans per 100 square feet of area.

Let the cover stay for 48 hours. Allow a week to ten days for the

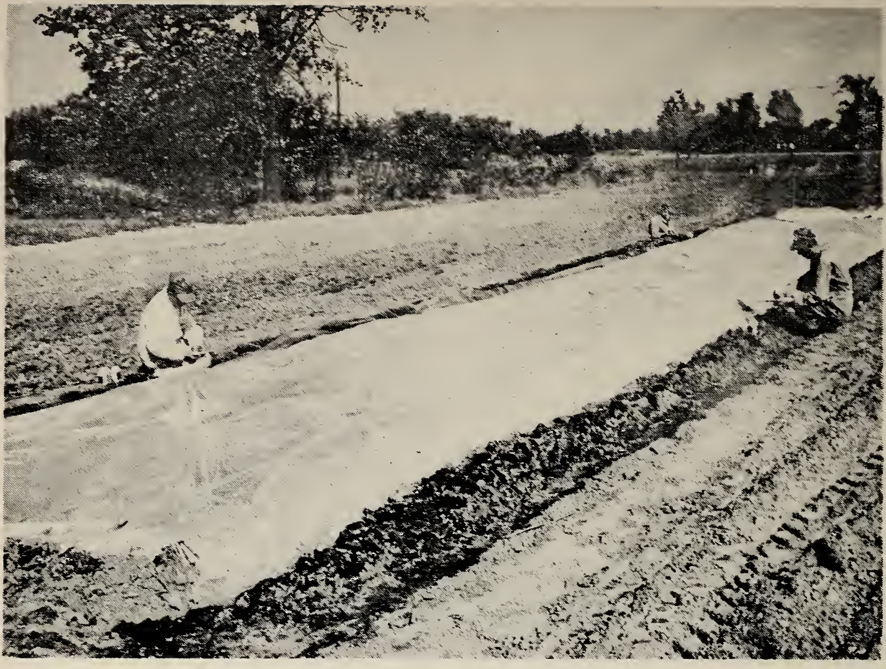

Fig. 70. Soil fumigation with methyl bromide ("MC-2"). (Photo by Dow Chemical Co.)

gas to leave the soil before planting.

Methyl bromide is very toxic to living plants. Do not use it any closer than about 2 feet to the roots of growing plants.

9. "Vapam" *(Sodium monomethyl dithiocarbamate).* This fumigant is new, and consequently, more information than now available about its action is needed before it would be safe to recommend it without reservations. It appears extremely promising. It possesses nematocidal, fungicidal, and herbicidal properties, and it is easy to handle and apply to the soil. No special applicators and no cover are needed. In a limited number of tests in Louisiana, Vapam gave excellent results when used to fumigate plant beds of pepper, tomato, and eggplant. In these tests, damping-off of seedlings was completely prevented. This means that Vapam is effective against the damping-off fungi. It is not definitely known whether or not it is effective against all kinds of pathogenic soil fungi; in fact, some of the available evidence indicates that, at the presently recommended dosages, it is not completely effective against the vascular wilt fungi (Fusarium wilt of tomato, for example).

Method of Application. Vapam is very easy to apply. Prepare the seedbed (or the garden) for planting. Dilute 1 quart of Vapam in enough water (about 3 gallons) in a sprinkling can to sprinkle evenly 100 square feet of area. Immediately sprinkle the treated area with enough water (about 20 gallons) to soak this solution down deep into the soil. No cover is necessary. Wait at least 3 weeks before seeding or planting. Heavy soils require a longer interval from treatment to planting than light, sandy soils.

CAUTION. All soil fumigants are poisonous, and some of them (methyl bromide and allyl alcohol, for example) extremely poisonous. Therefore, they should be treated with care and respect. In using any of these chemicals, be sure to read carefully and follow the recommendations of the manufacturer as printed on the container.

Section IV. Plant Injury As Caused by Herbicides and Defoliants[6]

During the last 10 years there have been many new chemicals developed for use as herbicides (weed killers) and defoliants (agents for removal of leaves from different crops). Whereas these chemicals are designed for the above uses, they will injure or kill most other plants. Therefore, extreme precautions must be taken in order to prevent injury to desired plants. The following discussion on injury will be limited to plants or crops other than those to which the herbicide treatment was applied.

How Injury May Occur

In most areas there are weeds growing either in crops or on roadsides, ditches, railroad right-of-ways, utility right-of-ways, fences and many other locations near desired plants. Chemical herbicides may be used by custom applicators, public service agencies or individuals to control the above vegetation. During and after application of herbicides desired plants may be injured in one or more of the following ways:

(1) by improper application techniques
(2) by using a dangerous herbicide in the vicinity of valuable plants
(3) by drift of herbicides due to wind
(4) by volatilization of the herbicide
(5) by rainwater washing herbicides
(6) by other methods such as dust, animals or humans
(7) by using equipment (sprayers, buckets, mixing containers) for insect or disease control that had been previously used for application of herbicides.

While some of the methods of causing injury mentioned above may appear rather farfetched they do occur quite commonly. In most cases there is little or nothing that can be done to overcome the injury once it has occurred. Therefore the only solution to the problem is to avoid contamination of desired vegetation.

How Injury May Be Avoided

Care and common sense are of extreme importance in preventing injury to desired plants by herbicides; however, some knowledge about the behavior of the herbicides is necessary. One of the first points to consider in using a herbicide is to read carefully the label on the herbicide container. Manufacturers are required by both state and federal laws to give certain information on the label of their product. Most manufacturers make direct statements on their label in regard to the use of their material near desired vegetation. If there are any questions in interpreting a label, consult the company representative, county agent, or the Extension Service. If the label suggests that a herbicide not be used around certain plants, do not use it.

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[6] This section was kindly prepared by Dr. Walter K. Porter, Jr.

Improper application techniques account for a large part of the injury caused by herbicides. For example, herbicidal application by air or by high pressure spray equipment may allow large quantities of the herbicide to be deposited on desired plants. Similarly, the above methods may allow injurious quantities of the herbicides to be moved by the wind (drift) for some distance from the treated area. Extreme caution should be exercised when high pressure application of herbicides is made in the vicinity of desired vegetation. Application should be made only when there is a low velocity wind blowing from the direction of desired vegetation.

All herbicides are dangerous to some degree; however, by the proper selection the chance of injury can be reduced. Some herbicides are volatile and should not be used near valuable plants. Similarly, certain herbicides may be moved long distances by run-off water and, as a result, cause injury or death to desired plants. Thus these materials should be used only in areas in which there will be no run-off.

Spray equipment that has been used for herbicide application should not be used for insecticide or fungicide application. The same is true for all mixing containers. While it is true that certain herbicides can be removed from spray equipment by various washing methods, this procedure is not recommended. All equipment for herbicide application should be carefully labeled (red paint to indicate danger is a good method) and stored separately from other spray equipment.

Since herbicides may be packaged in containers similar to those used for packaging insecticides and fungicides, it is very easy for laborers to become confused as to the identity of the containers. Therefore, herbicides should not be stored in the same buildings with insecticides and fungicides.

Herbicides Which May Cause Injury to Desired Plants

The following list includes some of the more common herbicides in use at the present:

(1) Phenoxy Type

(a) 2, 4-D (2, 4-dichlorophenoxyacetic acid)
(b) 2, 4, 5-T [2 (2, 4, 5-trichlorophenoxyacetic acid)]
(c) 2 (2, 4, 5-TP) (2, 4, 5-trichlorophenoxypropionic acid)
(d) M. C. P. A. (2-methyl-e-chlorophenoxyacetic acid)

(2) Urea Type

(a) Monuron or Karmex W or Telvar W [3-(p-chlorophenyl)-1, 1-dimethyl urea]
(b) Diuron or Karmex D, or Karmex DL, or Telvar D [3-(3, 4-dichlorophenyl)-1, 1-dimethyl urea]

(3) Chloroacetic Acid Type

(a) TCA (trichloroacetic acid)
(b) Dalapon (2, 2-dichloropropionic acid)

(4) Miscellaneous Herbicides and Defoliants

(a) chlorates (sodium or magnesium salts of chlorate)
(b) borate (various borates or mixtures)
(c) P.C.P. (pentachlorophenol)

Some Types of Injury Caused By the Above Herbicides

It is not possible to give complete details of injury types caused by the various herbicides. Therefore, only some of the more general types of plant reactions will be discussed. These discussions will be restricted to broadleaf type plants.

The phenoxy type materials at high rates will cause leaf burns, discolorations, leaf shed, and possible death of desired plants. At lower rates (generally caused by drift or minor contaminations from equipment) they may cause stem twisting, petiole twisting, leaf discolorations, leaf malformations, and stunting (Fig. 71). Most of the symptoms caused by low rates of phenoxy materials are confined to the new growth following contamination of the plant. The phenoxy materials, (namely 2, 4-D, 2, 4, 5-T and MCPA) will also cause leaf malformation in some plants which may be called "crazytop"—that is, the new plant leaves may be strap shaped or sawtooth edged. If only a few leaves are twisted or malshaped and recover in a short time the plants will most likely produce a normal yield. If for a long period—several weeks—the plant continues to produce malshaped leaves, the yield will most likely be reduced. Many factors may play a part in determining the seriousness of the injury—the age of plant, stage of development, and weather conditions following contamination. For example, less than ½ gram (.001 pound) of 2, 4-D per acre may reduce the yield of cotton as much as 20-25 per cent if it contaminates the plant in the seedling stages.

The urea type herbicides are powerful plant killers and remain in the soil for lengthy periods. They should not be used in areas in which the run-off water is likely to come into contact with desired vegetation. Also they should not be applied in an area

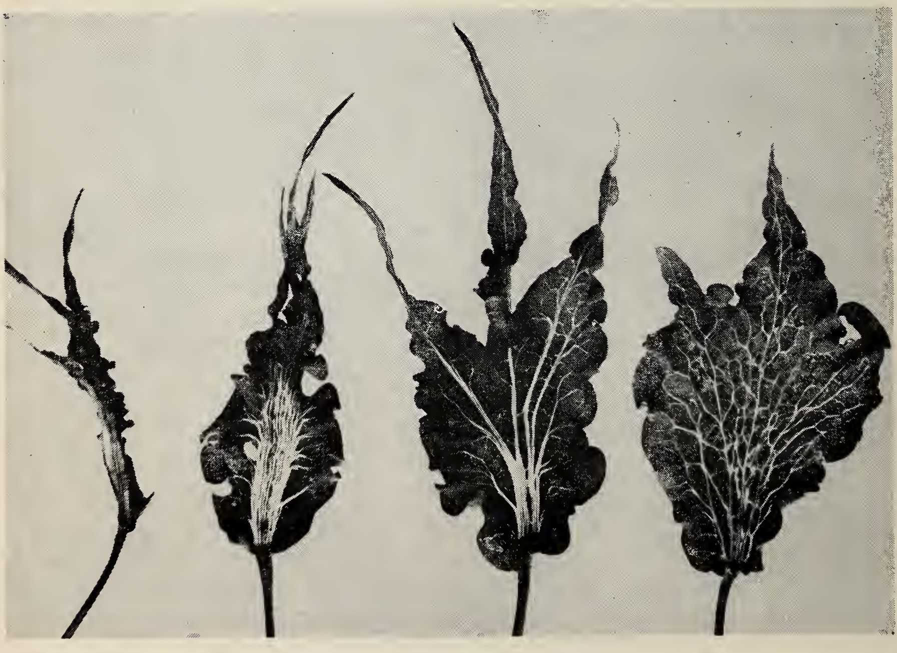

Fig. 71. 2, 4-D injury to cotton.

in which the roots of desired trees might contact the treated area. The roots of trees may cover an area many times that of the branches. The general symptoms of urea injury are leaf tip yellowing followed by progressive dieback of the new leaves. On older leaves the symptoms are yellowing along the veins followed by leaf shed. New leaves following leaf shed will respond according to the general symptoms. Small succulent plants may die rapidly, whereas trees may show symptoms two or three years before death.

The chloroacetic acid herbicides are most likely to injure young succulent plants. Since the life of these herbicides in the soil is rather short, little injury to trees will be caused by them when low general spray rates are used. However, high rates, sprayed either on the soil or on the plants, may severely injure or kill them. Typical symptoms to plants are leaf burn and chlorosis (Fig. 72) followed by leaf deterioration.

Many so-called contact herbicides or defoliants will kill or injure many different plants. Since most defoliant applications are made by air, the likelihood of damage is great. Defoliant drifts are particularly troublesome in the cotton producing area. In most cases, on trees, defoliants cause leaf burn followed by leaf shed with little or no permanent damage. Small valuable shrubs, especially those that are rapidly growing, may be killed.

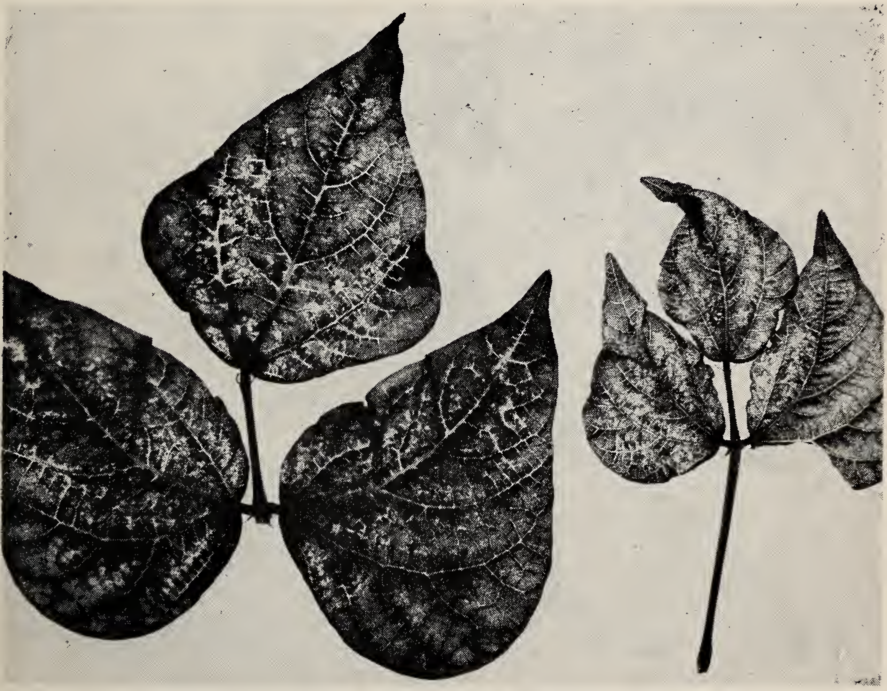

Fig. 72. TCA (Trichloroacetate) injury to bean.

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LOUISIANA BULLETIN NO. 358 JANUARY, 1943

STUDIES ON THE USE OF DEHYDRATED SWEET POTATO MEAL IN CHICK RATIONS

By

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AGRICULTURAL EXPERIMENT STATIONS

W. G. TAGGART, *Director*

STUDIES ON THE USE OF DEHYDRATED SWEET POTATO MEAL IN CHICK RATIONS

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INTRODUCTION

The use of dehydrated sweet potato meal as a carbohydrate feedstuff for poultry and livestock has attracted considerable interest within recent years. The southern section of the United States is a "feed-deficient" area, particularly so in carbohydrate feedstuffs. Of such feeds, corn is the most widely used; but the soil, climatic conditions and types of farming make it impossible to produce locally an adequate supply of this grain. Many areas in the South are better adapted to the production of sweet potatoes than of corn. In Louisiana, for example, the average production of corn for the ten year period, 1929-1938 was 14.5 bushels per acre, while the average production of sweet potatoes for the same period was 70 bushels per acre. According to Morrison (1936), number 2 dent corn contains 87.2 per cent dry matter and sweet potatoes contain 31.5 per cent dry matter. On this basis one acre of corn will yield 708.06 pounds of dry matter and one acre of sweet potatoes will yield 1,102.5 pounds of dry matter.

Fresh sweet potatoes have been used to a limited extent in poultry and livestock feeding for many years; however, because of the bulkiness of sweet potatoes, most farm animals cannot consume a sufficient quantity to supply the energy needs of their bodies. This limitation has led to the development of sweet potato dehydrators, many of which are operating in the South at the present time.

The production of dehydrated sweet potatoes which is usually ground into a meal naturally raised questions concerning its use and place in the rations of farm animals. Since this is a relatively new feedstuff, there have been very few experimental studies reported concerning its nutritive value. Lease and Mitchell (1940) studied the influence of sweet potato meal in the ration of laying hens upon the vitamin A content of eggs. Egg yolks from hens on a vitamin A deficient diet contained eight blue units of vitamin A per gram of yolk. Thirty days after the hens were placed on a ration containing 25 per cent of sweet potato meal, the vitamin A content of the egg yolks increased to 42 blue units per gram. Work is in progress at practically all of the Agricultural Experiment Stations in the South on the use of sweet potato meal, particularly in the rations of cattle and swine. The work reported in this publication summarizes the results of studies conducted to determine the relative value of dehydrated sweet potato meal compared to other carbohydrate feeds and the extent to which it can be used in chick rations.

EXPERIMENTS AND RESULTS

Because of the nature of this investigation, it was necessary to modify slightly the experimental procedure as the work progressed. For convenience in presenting and discussing the data, the experiments were divided into three groups which are designated as series A, B, and C. Each series will be discussed later in the order named.

A total of nine experiments were conducted which involved the use of 2,200 day-old chicks. The experiments in series A were conducted for a period of weeks. The experiments of series B and C were continued for only eight weeks, in order to complete as many experiments as possible during the time available for this project. Each experiment included 10 pens of 25 chicks each. The experimental rations were fed to duplicate or triplicate pens in each experiment. The sweet potato meal used in these tests was made from Puerto Rico potatoes and was dehydrated by the "lime process."

The chicks were weighed individually and the feed consumption determined at weekly intervals. Notations of abnormal symptoms were recorded at each weighing. All growth data were weighted for sex influence in computing the final summaries. This was done by adding the average weight of the males and the average weight of the females in each pen and dividing the total by two.

The term "index number" is used in these studies in comparing the growth of the chicks on the experimental rations to the reference of control ration. In computing "index numbers," the weighted average of the chicks in the control pen was given a relative value of 100. The weighted average of the chicks in the different experimental pens was divided by that of the control ration and the quotient multiplied by 100.

All growth data obtained in these experiments were analyzed statistically by the method of analysis of variance. The degree of significance of the difference between pens was determined by the "t" test. The feed ingredients used were analyzed for protein content and combined so that the protein content of each ration was 18 ± 0.1 per cent in the experiments of series A and 19 ± 0.1 per cent in the experiments of series B and C. In all of the experimental rations the calcium and phosphorous contents were adjusted to 1.5 ± 0.05 and 0.80 ± 0.05 per cent respectively.

Experiments of Series A

The experiments of series A were designed to determine the relative value of sweet potato meal as a substitute for yellow corn meal. The rations used in this series are shown in table 1. Ration 1 was the control or reference ration. The other rations contained varying amounts of sweet potato meal which was added in the place of a similar quantity of yellow corn meal. The three experiments in series A were conducted in the fall, winter, and spring of 1940-41. Single Comb Rhode Island Red chicks were used in experiment 1 and White Plymouth Rock chicks were used in experiments 2 and 3.

Statistical analysis of the results of these feeding trials showed that no significant difference existed between comparable pens in the different experiments; therefore, the results of the three experiments were combined as shown in table 2. The results as given in this table are based upon 150 chicks per ration.

From the data presented in table 2 it is obvious that the rations containing 10 and 20 per cent of sweet potato meal are not significantly different from the reference ration. The differences between the reference ration and the rations containing 30 and 40 per cent of sweet potato meal were statistically significant.

The efficiency of feed utilization followed about the same trend as the growth data. The rations containing the lower levels of potato meal were utilized about as efficiently as the reference ration, whereas the rations containing higher levels of potato meal were utilized somewhat less efficiently.

Mortality was relatively high in all pens. However, since most of the deaths occurred during the first two weeks of the experiments, it is doubtful that the mortality can be attributed to the rations used.

INGREDIENTS	Ration 1 Reference	Ration 2 10% S. P. M.*	Ration 3 20% S. P. M.	Ration 4 30% S. P. M.	Ration 5 40% S. P. M.
	lbs.	lbs.	lbs.	lbs.	lbs.
Yellow corn meal	45.00	34.50	22.50	11.00	.....
Sweet potato meal	.....	10.00	20.00	30.00	40.00
Wheat bran	10.00	10.00	10.00	10.00	10.00
Wheat shorts	10.00	10.00	10.00	10.00	10.00
Pulverized oats	10.00	10.00	10.00	10.00	10.00
Dried skim milk	5.00	5.00	5.00	5.00	5.00
Shrimp meal	8.00	10.00	10.00	10.50	12.00
Soybean oil meal	8.00	7.00	9.00	10.00	9.75
Oyster shell flour	1.00	2.00	1.50	2.00	1.25
Steamed bone meal	2.00	0.50	1.00	0.50	1.00
Cod liver oil	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
TOTAL	100.00	100.00	100.00	100.00	100.00

*S. P. M. = Sweet potato meal.

TABLE 2. EXPERIMENTAL OUTLINE AND A COMBINED SUMMARY OF THE RESULTS OF EXPERIMENTS 1, 2, AND 3, SERIES A.

PENS AND RATIONS	Wted. Ave. at 10 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Gms.	lbs.			
1 and 10—Reference	886.5	1.95	3.46	100	16
2 and 9—10% S. P. M.*	871.4	1.92	3.46	98	17
3 and 8—20% S. P. M.	861.5	1.90	3.66	97	11
4 and 7—30% S. P. M.	791.5	1.74	4.10	89	24
5 and 6—40% S. P. M.	750.4	1.65	4.30	85	23

*S. P. M. = Sweet potato meal.

Experiments of Series B

The experiments of series B were conducted to compare the feeding value of dehydrated sweet potato meal to that of wheat bran, rice bran, and pulverized oats. The rations used in this series are shown in table 3. Ration 1 of table 3 is a practical chick ration and was used as the reference ration. Each of the experimental rations contained corn meal plus 25 per cent of one other carbohydrate feed in addition to the protein, mineral, and vitamin supplements. Series B included two experiments which were conducted in the late spring and early summer of 1941. White Plymouth Rock chicks were used in both experiments.

TABLE 1. REFERENCE RATION AND METHOD OF ADDING SWEET POTATO MEAL (SERIES A)

An analysis of the results obtained from the duplicate experiments showed that the differences between comparable pens were not statistically significant; therefore, the results of the two experiments were com-

TABLE 3. RATIONS USED IN THE FEEDING TRIALS OF SERIES B

INGREDIENTS	Ration 1 Reference	Ration 2 S. P. M.*	Ration 3 Wheat bran	Ration 4 Pulv. oats	Ration 5 Rice bran
	lbs.	lbs.	lbs.	lbs.	lbs.
Yellow corn meal	20.00	35.50	44.50	41.00	41.00
Sweet potato meal	.....	25.00	.....	.....	.....
Wheat bran	20.00	.....	25.00	.....	.....
Wheat shorts	20.00	.....	.....	.....	.....
Pulverized oats	13.50	.....	.....	25.00	.....
Rice bran	.....	.....	.....	.....	25.00
Dried skim milk	5.00	5.00	5.00	5.00	5.00
Alfalfa leaf meal	5.00	5.00	5.00	5.00	5.00
Shrimp meal	6.625	13.00	8.625	10.25	10.375
Soybean oil meal	6.625	13.00	8.625	10.25	10.375
Oyster shell flour	2.00	0.50	0.75	0.50	1.00
Steamed bone meal	0.25	2.00	1.50	2.00	1.25
Cod liver oil	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
TOTAL	100.00	100.00	100.00	100.00	100.00

*S. P. M. = Sweet potato meal.

TABLE 4. EXPERIMENTAL OUTLINE AND A COMBINED SUMMARY OF THE RESULTS OF EXPERIMENTS 1 AND 2, SERIES B.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference	583.8	1.29	3.94	100	17
2 and 9—S. P. M.*	586.4	1.29	3.69	101	15
3 and 8—Wheat bran	665.0	1.47	3.30	114	7
4 and 7—Pulverized oats	653.8	1.44	3.18	112	11
5 and 6—Rice bran	628.6	1.39	3.24	108	11

*S. P. M. = Sweet potato meal.

bined and are summarized in table 4. The small difference between the average weight of the chicks receiving the reference ration and those receiving the potato meal ration was not significant. However, the pens of chicks receiving wheat bran, pulverized oats, and rice bran made significantly greater gains and utilized their feed more efficiently than those receiving the reference ration or the potato meal ration. The mortality which occurred could not be attributed to the conditions of the experiment.

Experiments of Series C

In the feeding trials of Series C, sweet potato meal and yellow corn meal were fed in combination with one other cereal feed in order to measure any supplementing effects that might result from the use of a wider variety of carbohydrate feedstuffs. The carbohydrates used, other than yellow corn meal and sweet potato meal, were wheat bran, wheat shorts, rice bran, rice polish, and pulverized oats. These rations are shown in table 5.

Two reference rations (rations 1 and 7 of table 5) were used in each experiment of this series. The practical chick ration used in series B was included as one reference ration and the other contained 40 per cent of sweet potato meal and 15 per cent of yellow corn meal. This latter ration was included in order to make it possible to measure more accurately any supplementing effects of the cereal feeds that were used in this series. Four experiments were conducted in series C. Experiments 1 and 2 were duplicates as were experiments 3 and 4; however, neither could be combined statistically because of the variations between the pairs of experiments. Rations 1, 2, 3, 4, and 7 of table 5 were used in experiments 1 and 2. Rations 1, 5, 6, and 7 of table 5 were used in experiments 3 and 4 of series C. These feeding trials were all conducted in the fall and winter of 1941-42. White Plymouth Rock chicks were used in each experiment.

The experimental outline and results of experiment 1 are summarized in table 6. The chicks in this experiment were grown in a warm room and an outbreak of colds occurred during the latter part of the experi-

TABLE 5. RATIONS USED IN THE FEEDING TRIALS OF SERIES C

INGREDIENTS	Ration 1 Reference	Ration 2 S. P. M.* and Wheat bran	Ration 3 S. P. M. and Rice bran	Ration 4 S. P. M. and Pulv. oats	Ration 5 S. P. M. and Wheat shorts	Ration 6 S. P. M. & Rice polishings	Ration 7 40% S. P. M.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Yellow corn meal	20.00	22.50	21.00	20.00	24.50	20.50	15.00
Sweet potato meal	.....	20.00	20.00	20.00	20.00	20.00	40.00
Wheat bran	20.00	20.00	......	......	......	......	......
Wheat shorts	20.00	......	......	......	20.00	......	......
Rice bran	......	......	20.00	......	......	......	......
Rice polishings	......	......	......	......	......	20.00	......
Pulverized oats	13.50	......	......	20.00	......	......	......
Alfalfa leaf meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Dried skim milk	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Shrimp meal	6.625	12.00	13.00	13.50	11.00	13.25	15.75
Soybean oil meal	6.625	12.00	13.00	13.50	11.00	13.25	15.75
Oyster shell flour	2.00	1.00	1.00	......	1.00	0.75	......
Steamed bone meal	0.25	1.50	1.00	2.00	1.50	1.25	2.50
Cod liver oil	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*S. P. M. = Sweet potato meal.

TABLE 6. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 1, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference	487.0	1.07	4.44	100	4
2 and 9—Wheat bran and S. P. M.*	498.4	1.10	4.39	102	14
3 and 8—Rice bran and S. P. M.	486.9	1.07	4.27	100	14
4 and 7—Pulv. oats and S. P. M.	560.9	1.24	3.92	115	6
5 and 6—40% S. P. M.	481.5	1.06	4.16	99	12

*S. P. M. = Sweet potato meal.

ment. These conditions resulted in slow growth. Only one ration in experiment 1 produced gains which differed significantly from the other rations. The chicks that were fed the pulverized oats and sweet potato meal ration utilized their feed more efficiently and made significantly greater gains than the chicks in any of the other pens. In view of the brooding difficulties experienced in this experiment the results should be accepted as tentative.

The outline and results of experiment 2 are summarized in table 7. Experiment 2 was conducted with the same rations and at the same time as experiment 1, but in a cold room brooder house. The chicks in experiment 2 grew better and utilized their feed more efficiently than the chicks of experiment 1 of this series. In the latter test, all of the experimental rations produced significantly greater gains than either of the reference rations. Mortality was reasonably low in each experiment.

Experiments 3 and 4 were duplicates and included only two experimental rations and the two reference rations. (See tables 8 and 9). Even though the average weights of experiments 3 and 4 differ appreciably in comparing one to the other, they agree fairly well when the rank of each pen within the experiments is compared. In both tests

TABLE 7. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 2, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 10—Reference	685.1	1.51	3.45	100	8
2 and 9—Wheat bran and S. P. M.*	722.8	1.59	3.24	106	2
3 and 8—Rice bran and S. P. M.	730.0	1.61	3.13	107	0
4 and 7—Pulv. oats and S. P. M.	733.6	1.62	3.11	107	4
5 and 6—40% S. P. M.	653.9	1.44	3.33	95	6

*S. P. M. = Sweet potato meal.

TABLE 8. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 3, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grams.	lbs.			
1 and 10—Reference..................	452.0	1.00†	4.85	100	40
3, 8 and 5—Wheat shorts and S. P. M.*	543.0	1.20	4.15	120	22
4, 7 and 6—Rice polishings and S P.M.	546.4	1.20	3.50	121	4
2 and 9—40% S. P. M...............	474.9	1.05	4.57	105	50

*S. P. M. = Sweet potato meal.

†The chicks in this trial were chilled early in the experiment which no doubt accounts for the high mortality and poor growth obtained.

the two experimental rations containing wheat shorts plus sweet potato meal and rice polishings plus sweet potato meal produced significantly greater gains than either of the reference rations. The differences between the two reference rations were not significant.

GENERAL DISCUSSION

This investigation was designed to determine to what extent sweet potato meal may be used in chick rations under practical conditions, and not to study quantitatively the different nutrients supplied by this feedstuff. It should be kept in mind that all of the sweet potato meal used in these studies was obtained from one dehydrating plant which used lime in the dehydrating process. While this product was quite uniform in color and composition, it is possible that sweet potato meal made by other processes or from other varieties of sweet potatoes may differ somewhat in its feeding value.

The rations which included sweet potato meal were eaten by the chicks as readily as the reference rations. The condition of the droppings from the chicks in all of the pens was normal. Therefore, it appears that sweet potato meal is palatable to chicks and has no undesirable physiological effects.

TABLE 9. EXPERIMENTAL OUTLINE AND A SUMMARY OF THE RESULTS OF EXPERIMENT 4, SERIES C.

PENS AND RATIONS	Wted. Ave. at 8 weeks		Grams of feed per gram gain	Index No.	Per cent mortality
	Grms.	lbs.			
1 and 8—Reference..................	533.8	1.18	3.79	100	10
3 and 6—Wheat shorts and S. P. M.*..	569.6	1.26	3.84	107	2
4 and 5—Rice polishings and S. P. M..	583.1	1.29	3.80	109	0
2 and 7—40% S. P. M...............	512.7	1.13	3.75	96	16

*S. P. M. = Sweet potato meal.

Some of the sweet potato meal used in these experiments was held in a feed room for as long as six months and did not show any signs of weevil infestation, mold, or other forms of decomposition. On the basis of this observation, it seems that the storing and keeping qualities of sweet potato meal are as good as any of the commonly used carbohydrate feedstuffs and considerably better than many of them.

The growth obtained from the practical chick ration that was used as one of the reference rations in the experiments of series B and C was poorer than had been expected. According to calculations based on average feedstuff composition figures this ration contained an adequate quantity of all the nutritive essentials known to be required by poultry. When other conditions are equal, rations containing a larger number of ingredients usually produce more rapid gains than do simple rations. This was not true of these experiments and there appears to be no satisfactory explanation for the discrepancy at the present time.

SUMMARY AND CONCLUSIONS

These studies were conducted to determine the feeding value of sweet potato meal in practical chick rations. Because of changes in the procedure, the experiments were divided into three series which were designated as series A, B, and C. The purpose of the experiments in series A was to determine to what extent sweet potato meal could replace yellow corn meal in practical chick rations. The experimental rations used contained 10, 20, 30, and 40 per cent of sweet potato meal in the place of a similar amount of yellow corn meal.

The experiments of series B were conducted to compare the feeding value of dehydrated sweet potato meal to that of wheat bran, rice bran, and pulverized oats when fed in combination with yellow corn meal as the only other carbohydrate feedstuff. A practical chick ration was used as the reference ration.

In series C two carbohydrate feeds were used in addition to sweet potato meal which made up 20 per cent of all the experimental rations. The carbohydrate feedstuffs were fed in various combinations in order to measure any supplementary effects that might result from using a larger number of feeds. Two reference rations were used in each experiment; one was a practical chick ration and the other contained 40 per cent of sweet potato meal and 15 per cent of yellow corn meal as the only carbohydrate feedstuffs.

From the data secured under the conditions of these experiments the following conclusions seem warranted:

1. When sweet potato meal was substituted for 10 and 20 per cent of the yellow corn meal in the experiments of series A, there were no differences between these two rations and the reference ration in the growth, mortality, or amount of feed required to produce one unit

of gain. Rations containing 30 and 40 per cent of sweet potato meal did not produce results as satisfactory as did the reference ration or the rations containing lower levels of potato meal.

2. The ration containing sweet potato meal in series B was as well utilized as the reference rations, but was slightly inferior to the rations containing wheat bran, rice bran, and pulverized oats.
3. Rations containing two cereal feeds in addition to sweet potato meal were as good as, and in some combinations significantly better than the reference rations, one of which was a practical chick ration.
4. Sweet potato meal was found to be palatable to chicks and did not have any undesirable physiological effects.
5. The storage and keeping qualities of sweet potato meal were equal to or better than that of the other carbohydrate feeds used.
6. Sweet potato meal was found to be a good carbohydrate feedstuff for practical chick rations and may be used to the extent of 20 or 25 per cent of the mash mixture in the place of other carbohydrate feeds.

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Performance of Irish Potato Varieties in Louisiana

By

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PERFORMANCE OF IRISH POTATO VARIETIES IN LOUISIANA[1]

By

E. L. LeClerg[2]

Due to the present scarcity of labor and increase in cost of production of Irish potatoes, the grower is confronted with problems that will require greater efficiency in every detail of his work. Also, the probable greater difficulty in obtaining nitrogenous fertilizers and chemicals for seed treatment makes it imperative to give more consideration to the many details involved in growing this crop.

During the past 10 years the United States Department of Agriculture and many of the potato-growing States have been trying to solve their major problems by producing new varieties with better quality, higher yielding ability, and resistance to diseases and insects. Fortunately some of these new varieties are quite well adapted to Louisiana conditions. If grown, they will be more profitable to the grower because of their high yields and their disease resistance.

For the past 3 years the United States Department of Agriculture in cooperation with the Department of Horticulture of the Louisiana State university has conducted yield tests with a number of the new varieties as well as some of the old ones in 4 locations in Louisiana. The results of these tests and a discussion of the new varieties are presented in this bulletin so as to assist the growers in formulating plans for increased production of potatoes during the present emergency.

PROCEDURE AND MATERIALS

The tests herein discussed included 13 varieties. The seed tubers of all of the varieties tested were grown each year by the United States Department of Agriculture at Presque Isle, Maine, and were kept in cold storage at Baton Rouge, Louisiana, until planting time.

Each test was arranged in randomized blocks with single-row replications of 25 hills each. Experiments were made at Baton Rouge and Lafayette in 1940, 1941, and 1942; at Houma in 1940 and 1942, and at Thibodaux in 1941 and 1942. The data were analyzed by the analysis of variance.

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[1] Cooperative investigations by the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Agricultural Research Administration, United States Department of Agriculture, and the Department of Horticulture of the Louisiana Agricultural Experiment Station.

[2] Pathologist, Division of Fruit and Vegetable Crops and Diseases, headquarters at Baton Rouge, Louisiana.

One should not conclude that one variety is of higher yielding ability than another when only small differences exist between them. There is no way to determine relative yielding ability of any crop with absolute accuracy. Difference in yield from adjacent plots, planted from the same seed lot, may occur, due in most cases to differences in soil. This effect of soil differences on yielding ability is overcome to a considerable extent by having a number of plots (replications) of each variety in the test. Even with replication, differences remain, which are said to be due to chance.

Methods of analysis of yield data are available to determine how large a difference is necessary between the yield of any two varieties to be considered a real difference. At the bottom of Table 1 is given the "differences required for signficance" between the mean yields of any two varieties. For the yield of two varieties to be significantly different from each other the difference between the mean yields should be as great or greater than the figures given at the bottom of Table 1. For example, compare Irish Cobbler and Triumph where the difference is 143—127=16 bushels. This difference is less than the 29 bushels needed for significance, thus indicating that the yielding ability of Irish Cobbler and Triumph was not significantly different in the tests under consideration.

NEW POTATO VARIETIES

Many of the diseases of potatoes in Louisiana are caused by viruses, others by fungi, and still others by bacteria. The most important virus diseases are leaf roll, spindle tuber, rugose mosaic, and mild mosaic. Common scab, early blight, and southern blight are the important fungus diseases. Bacterial ring rot is the most destructive bacterial disease in Louisiana.

The production of new potato varieties resistant to disease is one of the principal objectives of those engaged in potato breeding in the United States.

The following discussion presents some of the outstanding characteristics of the new potato varieties that were included in the yield tests.

EARLY-MATURING VARIETIES

Earlaine

The Earlaine potato was developed by the United States Department of Agriculture at Presque Isle, Maine. It originated from a cross between Irish Cobbler and an unnamed seedling variety, S43055, the ancestry of which included 3 early varieties, Irish Cobbler, Triumph, and S24642.

The tubers are white, round, regular in outline, with eyes of medium depth. This variety is very highly resistant to mild mosaic under field conditions. Under Louisiana conditions Earlaine is somewhat later in maturity than Triumph.

Red Warba

The Red Warba was developed by the Minnesota Agricultural Experiment station. It is a sport from the Warba variety.

The tubers are round, with eyes of medium depth. The skin is smooth and red with white striations or blotches. These blotches do not affect the cooking quality of the tubers. Red Warba has resistance to mild mosaic. This variety matures in about the same length of time as Triumph.

Warba

Warba is also the result of potato breeding work by the Minnesota Agricultural Experiment station.

The tubers are round and blocky. The skin is smooth and creamy white. Eyes are pink and of medium depth. The vines of Warba are less injured by excessive heat than those of the Triumph variety. This variety is resistant to mild mosaic, and is as early as Triumph.

LATE-MATURING VARIETIES

Chippewa

The Chippewa was produced as a result of the potato-breeding program of the United States Department of Agriculture. This variety also has shown a high degree of resistance to mild mosaic. It is not resistant to leaf roll or spindle tuber. Under conditions of hot, dry weather the leaves of Chippewa are severely affected by non-virus leaf roll. Under these conditions rolling extends from the base to the top of the plant.

The tubers are smooth, regular in form, and oblong to egg-shaped. They are slightly longer in proportion to the width than the tubers of Katahdin. The eyes are few in number and very shallow.

Chippewa is slightly earlier than Katahdin in Louisiana. It does not keep in storage as well as Katahdin.

Houma

The Houma variety was produced by the United States Department of Agriculture and selected by the Louisiana Agricultural Experiment station. This variety combines resistance to mild mosaic with the ability to produce large yields of smooth tubers of very high cooking quality. Houma is susceptible to leaf roll, spindle tuber, rugose mosaic, and early blight. Shortly after this potato was named it was observed in Louisiana that early blight attacked this variety at an early stage of development causing destruction of foliage before the plants were very large.

The tubers are smooth, with shallow eyes, nearly round, and slightly flattened at the apex. Houma is somewhat earlier than Katahdin under Louisiana conditions.

Katahdin

The Katahdin is a white potato produced by the United States Department of Agriculture. One of the important characteristics of this variety is its ability to produce tubers with desirable shape even under adverse soil and climatic conditions. It is one of the most widely adapted varieties now grown.

The tubers are round to oblong, and thick; usually more nearly round. The skin is smooth and the eyes are few and very shallow. Tuber formation begins very early in the season.

The Katahdin was bred for resistance to mild mosaic. This disease has never been observed in any Katahdin fields in Louisiana. It also possesses some resistance to rugose mosaic. The Katahdin, however, is very susceptible to leaf roll and spindle tuber. Under hot, dry weather conditions the lower leaves of this variety frequently roll and resemble leaf roll.

The Katahdin has excellent keeping qualities. Therefore, growers with adequate storage facilities should find this a good potato to supply local and southern markets after the shipping season for Triumph is completed.

Mohawk

The Mohawk potato is the latest of the new varieties produced by the United States Department of Agriculture. It is a selection from the cross of Green Mountain and Katahdin.

The tubers are white, somewhat oblong, smooth, with medium shallow eyes. It is later in maturity than Katahdin in Louisiana.

Pontiac

Pontiac is a selection from a cross between Triumph and Katahdin, made at the Michigan Agricultural Experiment Station.

The tubers are red, large, oval to somewhat flattened, with deep eyes. As far as is known it is not especially resistant to any disease. In Louisiana this variety is somewhat earlier than is Katahdin.

Sebago

Sebago was produced as the result of breeding for resistance to late blight by the United States Department of Agriculture. While it is not as highly resistant to late blight as desired, it has shown more resistance than any of the commonly grown commercial varieties in many areas. It is resistant enough to late blight, however, to be grown in most seasons without spraying, and in seasons of severe epidemics it would require fewer applications of Bordeaux mixture than the more susceptible sorts. Its tubers show considerable resistance to the tuber rot initiated by the late-blight fungus.

Sequoia

The Sequoia variety was recently selected by the North Carolina Agricultural Experiment station in cooperation with the United States Department of Agriculture. It was selected because of its ability to withstand attacks of late blight, leafhoppers, and flea beetles.

This potato is very late, but produces large, smooth, somewhat flattened tubers.

It is well to remember that a variety of potatoes that does well in one section of the country may be of little value in another. Therefore, do not buy high-priced seed because some new variety is superior in some other section, without knowing that it is adaptable to your conditions. Information on this point can be secured from your county agricultural agent or from the Department of Horticultural Research of the Louisiana State university at Baton Rouge. Comparative yield tests of new varieties are made at Baton Rouge and information can be furnished regarding the behavior of new varieties. If the new variety has not been tested, it is advisable to buy only a small quantity of seed stock and try it the first year alongside of your standard variety.

RESULTS OF TESTS

The average yield of No. 1 tubers of the 13 varieties is given in Table 1 for all of the tests at the 4 locations and the percentage of No. 1 tubers is given in Table 2. In summarizing the data the varieties have been divided into two groups on the basis of early and late maturity.

Early-Maturing Varieties

It is apparent that of the early-maturing red varieties, Red Warba yielded at least twice as many bushels per acre as did Triumph at each of the locations (Table 1). In addition to the greater yield, this variety produced about 20 per cent more No. 1 tubers than did Triumph (Table 2). Red Warba is as early as Triumph and has resistance to mild mosaic, which is one of the causes of "running out" of potatoes. Of the early, white varieties, Warba is far superior in yielding ability and production of percentage of No. 1 tubers to either Irish Cobbler or Earlaine in Louisiana.

Reports indicate that the acreages of Red Warba and Warba are increasing each year. Latest figures show that about 55,000 bushels of Red Warba and 44,000 bushels of Warba were certified for seed in 1941, the greater part being grown in Minnesota. With the exception of color, these two varieties are very similar. The Red Warba, a sport of Warba, produces red tubers with splashes of white and the Warba produces white tubers with pink eyes. These varieties have been discriminated against to a certain degree in the past because of their tuber color. Both, however, are very early and produce high yields in Louisiana.

Due to the demand for greater production, it may be that these color characters of the tubers may be less objectionable now than previously. The Red Warba probably would compete better with Triumph than Warba because it is red in color. Due to its higher yielding ability and earliness, it may find a place in the early-production areas of Louisiana.

Late-Maturing Varieties

Consideration of the 7 late, white varieties shows that Katahdin, on the average, produced the highest yield (Table 1). With regard to the percentage of No. 1 tubers, this variety was as good or better than any other variety tested (Table 2).

The Katahdin keeps very well in storage. Hence growers with proper storage facilities on the farm should find this variety well adapted for supplying the local and southern market after the early shipping season is completed.

The resistance of Katahdin to mosaic diseases is a very desirable character, considering the necessity of purchasing seed stocks each year. It can be grown for at least 2 years from home-grown seed, provided the best certified seed is obtained the first year and subsequent crops are not grown too close to potato fields containing virus diseases. Obviously, this will eliminate the outlay of money for certified seed each year. Due to the high cost of good certified seed, caused by the war situation, this represents a very important consideration in any potato-production program.

The most serious undesirable character of the Katahdin is the small number of eyes on the tubers. This feature necessitates special care in cutting to insure that there is an eye on each seed piece. This, of course, results in making the cost of seed per acre somewhat higher than if varieties with more eyes on the tubers were used. However, this additional cost is more than offset by the high yields obtained and the fact that home-grown seed can be saved and planted for at least 2 seasons.

TABLE 1. FIELD (BUSHELS PER ACRE) OF NO. 1 TUBERS OF 13 VARIETIES OF IRISH POTATOES TESTED IN LOUISIANA.

VARIETY	Tuber Color	BATON ROUGE*		LAFAYETTE*		HOUMA*		THIBODAUX*	
		3-year average	2-year average	3-year average	2-year average	2-year average	1-year average	2-year average	1-year average
Early-maturing varieties									
Red Warba	Red	...	215	...	152	...	190	...	231
Warba	White	205	214	137	132	179	172	138	235
Irish Cobbler	White	143	148	130	124	142	123	110	...
Earlaine	White	133	136	86	75	152	168	122	157
Triumph	Red	127	127	102	74	151	84	84	130
Late-maturing varieties									
Pontiac	Red	...	214	...	158	...	171	165	177
Katahdin	White	186	212	158	170	175	172	138	218
Houma	White	177	187	147	155	184	173	152	176
Green Mountain	White	150	164	137	152	162	161	152	200
Chippewa	White	149	156	118	114	131	93	156	...
Sebago	White	148	152	157	170	168	188	131	161
Mohawk	White	138	151	100	94	132	130	117	172
Sequoia	White	...	139	...	175	...	148	137	159
Difference required for significance		29	32	31	27	33	23	32	41

Not all varieties were tested each year. The two averages represent the yields for the respective number of years the varieties were tested at each location.

TABLE 2. PERCENTAGE OF NO. 1 TUBERS PRODUCED BY 13 VARIETIES OF IRISH POTATOES TESTED IN LOUISIANA.

VARIETY	Baton Rouge	Lafayette	Houma	Thibodaux	Average
Early-maturing varieties					
Red Warba	82	79	78	73	78
Warba	84	81	77	74	79
Irish Cobbler	72	77	76	74	75
Earlaine	69	60	68	76	68
Triumph	72	62	67	56	64
Late-maturing varieties					
Pontiac	86	80	83	83	83
Katahdin	82	83	82	80	82
Houma	79	77	76	73	76
Green Mountain	76	71	82	80	77
Chippewa	75	66	65	82	72
Sebago	80	78	82	85	81
Mohawk	81	79	82	73	79
Sequoia	79	86	84	89	84

SUMMARY

Yield tests with a number of new Irish potato varieties as well as some old ones were made in Louisiana for three years at four locations.

Of the early-maturing red varieties, Red Warba yielded at least twice as many bushels per acre as Triumph at each of the locations. In addition, this variety produced about 20 per cent more No. 1 tubers than Triumph. Red Warba is as early as Triumph and moreover has resistance to mild mosaic, which is one of the causes of "running out" of potatoes.

Katahdin was the highest yielding late, white variety. With regard to the percentage of No. 1 tubers, this variety was as good or better than any variety tested.

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A STUDY OF THE ADEQUACY OF DIETS CONSUMED BY GRADE-SCHOOL AND HIGH-SCHOOL STUDENTS IN LOUISIANA

By

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A STUDY OF THE ADEQUACY OF DIETS CONSUMED BY GRADE-SCHOOL AND HIGH-SCHOOL STUDENTS IN LOUISIANA

By

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INTRODUCTION

The advent of the present war has served to make many Americans conscious of existing conditions which had not been fully realized previously. One of the most outstanding of these conditions is the development of a state of "nutrition-consciousness" throughout the country. This awakening had its beginning when the Selective Service Act went into effect, at which time it was discovered that approximately 400,000 out of every 1,000,000 registrants examined (40%) were unfit for general military service, with probably one-third of this number suffering from disabilities directly or indirectly concerned with nutrition.[6]

A research program was organized by the Louisiana Agricultural Experiment station in cooperation with several other agencies in the State for the purpose of studying the adequacies of diets served by various groups. The groups included in the studies thus far conducted are grade-school and high-school students throughout the State, Farm Security Administration families, and home demonstration club members' families. This bulletin, however, deals only with a study of the adequacy of diets of grade-school and high-school students. Similar studies dealing with the other groups mentioned above have already been reported.[7]

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[6] Hershey, Lewis B., Selective Service and its Relation to Nutrition, *Proceedings National Nutrition Conference for Defense,* page 67, May, 1941, United States Government Printing Office, Washington, D. C.

[7] Grigsby, Nora E.; McBryde, Laureame C. and Davis, Horace J.—*A Study of the Adequacy of Diets of Farm Security Administration Families in Louisiana.*—Nutrition Laboratories, L. S. U., Baton Rouge, La. (Mimeographed Leaflet).

[8] Bryson, Bertha E.; Tucker, Clara, and Davis, Horace J.—*A Study of the Diets of Home Demonstration Club Members' Families in Twenty-Seven Parishes in Louisiana*—Louisiana Bulletin No. 356, L. S. U. Experiment Station, Baton Rouge, La.

Collection and Analysis of Data

In collecting these data, a survey form was developed which, when properly filled out, showed the foods consumed at each meal for a one-week period. These record forms were distributed among the schools in New Orleans by the chairman of the Orleans Parish Nutrition Committee; the Crowley High School records were obtained by the principal of the Crowley High School; and the records from other grade schools and high schools throughout the State were collected by the State Department of Health. A total of 5,776 records were collected from New Orleans schools, 387 from the Crowley High School, and 545 from grade schools and high schools in other areas of the State. In the latter group, a relatively small number of records were obtained from numerous schools. Since the number of records obtained from any one school was insufficient to be considered representative of the entire school, they were all summarized into one group and are reported under the heading "Other Schools." These 545 dietary records were obtained from children who had been examined by officials of the State Department of Public Health and at the same time judged and classified in regard to their nutritional status.

In evaluating the dietary records obtained, a score card was developed which was patterned after the so-called Nutritional "Yardstick" or dietary "pattern." This "yardstick" was established by the Food and Nutrition Committee of the National Research Council at the National Nutritional Conference held in Washington, D. C., May 26-28, 1941. The Food and Nutrition Committee was composed of 28 outstanding authorities in the field of food and nutrition. The "yardstick" which the committee recommended as a guide for planning the daily menu may be summarized as follows:

Milk, adults 1 pt., children 1½ pts. to 1 qt.
Eggs, 3 or 4 times per week.
Meat, 1 serving (1 oz. at 1 yr. up to 3 ozs. for adults.)
Vegetables, 2 servings. One green or yellow.
Fruit, 2 servings. One citrus or tomato and one other, as apple, prunes, etc.
Potato, one or more servings.
Butter, or fortified oleomargarine. (100-500 calories).
Whole grain or "enriched" cereal and bread, at least half of the intake.
Sugar, fat, etc., to complete calories.

By combining the above "yardstick" with a more simple and less expensive dietary "pattern" proposed by workers in the United States Department of Agriculture, a score card was developed for evaluating the adequacy of the diets studied. This score card included the recommended servings of the protective foods (milk, eggs, lean meat, fresh vegetables, etc.) on a per-week basis as shown in Figure 1.

FIGURE 1. A SCORE CARD FOR DETERMINING THE ADEQUACY OF DIETS

	SERVINGS PER WEEK		
	Good	Fair	Poor
Milk	14 or more	8–13	7 or less
Butter	14 " "	8–13	7 " "
Eggs	5 " "	3– 4	2 " "
Lean meat or substitute*	7 " "	4– 8	3 " "
Vegetables			
Green, leafy, or yellow	7 " "	4– 6	3 " "
Others	7 " "	4– 6	3 " "
Potatoes	7 " "	4– 6	3 " "
Whole grain cereals	10 " "	5– 9	4 " "
Fruits			
Citrus fruits or tomatoes or	7 " "	4– 6	3 " "
Raw vegetables†	7 " "	4– 6	3 " "
Other fruits	7 " "	4– 6	5 " "

*Lean meat as such must appear in the menu at least four times per week. Meat substitutes include cheese, dried peas or beans, and soybeans.

†The only raw vegetables which may be included in this group are cabbage, green peppers, and radishes.

In applying the score card, each of the ten foods or food groups was scored as good, fair, or poor, depending on the number of times it was served during the week. A diet that measured up to the recommendations of the "yardstick" obviously scored good in all respects. If a food was served only one half as many times during the week as is recommended in the "yardstick" it was classed as poor. Foods that were served more than one half, but less than the recommended number of times per week, were classed as fair (Figure 1). This method of analysis made it possible to classify each of the ten foods as good, fair, or poor.

After classifying the foods individually, the total diet was classed either as good, fair, or poor. In making this classification, a simple method was developed whereby each of the ten foods was given a value of three, two, or one. All foods that were classed as good were given a score of three, all foods that were classed as fair were given a score of two, and all foods that were classed as poor were given a score of one. The scores of the individual foods were totaled to obtain a score for the whole diet. A diet that conformed to the "yardstick" in all respects received a score of 30. After scoring numerous diets and then calculating their compositions in terms of food nutrients (protein, vitamins, minerals, etc.) it was found that diets which received a total score of 25 or more were adequate in all known respects and therefore were classed as good. The diets that scored from 15 to 24 points were classed as fair, and those that scored 14 or less were classed as poor. In using this system of evaluating diets, a good diet may be defined as one which is adequate in all known respects. A poor diet is distinctly deficient in one or more of the food factors necessary for optimum health. Diets that were classed as fair may be defined as borderline diets. In many cases they do not supply enough of the various food factors—vitamins, minerals, and protein in particular—to meet adequately the requirements of the individual.

Results and Discussion

A summary of the adequacy of diets consumed by the three groups of grade-school and high students is shown in Table 1. There is very little variation in the per cent of diets that scored good. In each group, the number of diets that scored good was quite small. The students in Crowley High School had a higher percentage of diets scoring fair and fewer scoring poor than the students from other schools studied. The diets consumed by the negro students were extremely poor. Fifty-eight per cent of the diets of negro students in New Orleans scored poor, and 75 per cent of the diets of negro students in other areas of the State scored poor. These findings lead one to wonder why nutritional deficiency diseases are not more commonly recognized among negroes.

TABLE 1. A SUMMARY OF THE ADEQUACY OF DIETS CONSUMED BY GRADE-SCHOOL AND HIGH-SCHOOL STUDENTS IN LOUISIANA.

	WHITE			NEGRO		
	Good	Fair	Poor	Good	Fair	Poor
Crowley High School						
Number	56	283	48	......	......	......
Per Cent	14.5	73.1	12.4	......	......	......
New Orleans Schools						
Number	513	2751	1349	38	443	682
Per Cent	11.2	59.6	29.2	3.3	38.1	58.6
Other Schools						
Number	23	138	94	1	71	218
Per Cent	9.0	54.1	36.9	0.3	24.5	75.2

A summary of the adequacy of the diets in each of the 10 protective foods consumed by white students is given in Table 2. While there was considerable variation in the adequacy of diets consumed by white students in different schools, they all followed about the same general pattern. For example, the consumption of meat or meat substitutes in all three groups of diets came nearer meeting the present recommendations than any of the other foods. Likewise, the consumption of whole grain cereals was lower (tenth) in all groups than was any other food. Taking all of the diets of white students as one group, the consumption of milk ranked second (next to meat); green, leafy, or yellow vegetables ranked third; eggs ranked fourth; other fruit (other than citrus) ranked fifth; vegetables (other than green, leafy, or yellow) ranked sixth; citrus fruit, tomatoes and raw vegetables ranked seventh; butter ranked eighth; and potatoes ranked ninth. Seven of the protective foods scored good in less than 50 per cent of the diets studied. It is to be expected that the use of certain vegetables will vary at different seasons of the year; however, it is doubtful if seasonal variations will explain the relatively poor score most of these diets received. All of these records were obtained during the

TABLE 2. A SUMMARY OF THE ADEQUACY IN EACH OF THE TEN PROTECTIVE FOODS OF DIETS CONSUMED BY WHITE STUDENTS.

	CROWLEY HIGH SCHOOL			NEW ORLEANS SCHOOLS			OTHER SCHOOLS		
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Milk									
Number	262	96	29	1936	1394	1256	125	84	46
Per Cent	67.7	24.8	7.5	42.6	30.2	27.2	49	32.9	18
Butter									
Number	73	94	220	1706	1072	1835	24	63	168
Per Cent	18.9	24.3	56.8	37	23.2	39.8	9.4	24.7	65.9
Eggs									
Number	125	138	124	990	1255	2368	82	80	93
Per Cent	32.3	35.7	32	21.5	27.2	51.3	32.2	31.4	36.5
Lean Meat or Substitute*									
Number	346	29	12	3688	548	377	186	46	23
Per Cent	89.4	7.5	3.1	79.9	11.9	8.2	72.9	18	9
Green, Leafy, or Yellow Vegetables									
Number	248	72	67	2266	1087	1260	67	68	120
Per Cent	64.1	18.6	17.3	49.1	23.7	27.3	26.3	26.7	47
Other Vegetables									
Number	149	125	113	1049	1089	2475	44	58	153
Per Cent	38.5	32.3	29.2	22.7	23.6	53.7	17.3	22.7	60
Potatoes									
Number	66	130	191	734	1428	2451	44	79	132
Per Cent	17.1	33.6	49.3	15.9	31	53.1	17.3	31	51.8

TABLE 2 (*Continued*). A SUMMARY OF THE ADEQUACY IN EACH OF THE TEN PROTECTIVE FOODS OF DIETS CONSUMED BY WHITE STUDENTS.

	CROWLEY HIGH SCHOOL			NEW ORLEANS SCHOOLS			OTHER SCHOOLS		
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Whole Grain Cereal									
Number	32	99	256	366	981	3266	13	58	184
Per Cent	8.3	25.6	66.1	7.9	21.3	70.8	5.1	22.7	72.2
Citrus Fruit, Tomatoes, or Raw Vegetables†									
Number	114	116	157	1174	1000	2439	47	62	146
Per Cent	29.5	30	40.5	25.4	21.7	52.9	18.4	24.3	57.3
Other Fruit									
Number	120	100	167	1478	1044	2091	63	63	129
Per Cent	31	25.8	43.2	32	22.6	45.3	24.7	24.7	50.6
TOTAL DIET									
Number	56	283	48	513	2751	1349	23	138	94
Per Cent	14.5	73.1	12.4	11.2	59.6	29.2	9.0	54.1	36.9

*Lean meat as such must appear in the menu at least four times a week. Meat substitutes include cheese, dried beans and peas, and soybeans.

†The only raw vegetables which may be included in this group are cabbage, green peppers, and radishes.

spring and early summer of 1942, at which time vegetables are relatively cheap and abundant in city markets. The Crowley area and other schools outside New Orleans have many pupils coming from rural areas where home gardens could have supplied an abundance of vegetables at this time of year.

A summary of the adequacy of diets in each of the 10 protective foods consumed by negro students is shown in Table 3. As a group, the diets consumed by the negro students were much poorer than those consumed by white students. The rank of the protective foods in these diets was quite similar to the diets of the white students with the exception of milk. The consumption of meat and meat substitutes ranked first as compared to the other foods, and scored good in approximately 70 per cent of the diets; eggs ranked second; green, leafy, or yellow vegetables ranked third; other fruit (other than citrus) ranked fourth; other vegetables including asparagus, cauliflower, turnips, etc., ranked fifth; potatoes ranked sixth; milk ranked seventh; citrus fruit, tomatoes, and raw vegetables ranked eigth; butter ranked ninth; and whole grain cereals ranked tenth.

From the results of this study it is difficult to say specifically which food factors are most often deficient in the diets of school children. The low consumption of whole grain cereals suggests a deficiency of vitamin B_1 (thiamin). The poor diets which were very low in all fruits and vegetables, milk, and butter, as well as whole grain cereals, would seem to be very low in minerals, all of the members of the B complex, vitamin C and vitamin A.

Nutritionists agree that the well defined deficiency diseases such as pellagra, resulting from a total lack of nicotinic acid; beriberi, resulting from a total lack of thiamine (vitamin B_1); or scurvy, resulting from a total lack of ascorbic acid (vitamin C) are of comparatively rare occurrence. There are, however, many indications of partial deficiencies which commonly occur in human diets, in varying combinations and in varying degrees. These include slow growth of the child; poor posture resulting from low muscle tone; underweight; fatigue; low resistance to infections; nervousness, restlessness and irritability; tender bleeding gums; scaly dry skin and skin eruptions; predilection to tooth decay; and some degree of night blindness. On the side of positive evidence, experience has shown that improvement of poor diets improves growth and general physical appearance of the child and increases physical endurance and mental alertness. Many teachers have reported that children show more interest, have more ability to concentrate, and decrease their absences due to illness, when a good school lunch program adds "protective foods" (foods having high mineral and vitamin content) to their diet. That the foundation of physical and nervous stamina for adult life are laid in childhood is a well known fact and good nutrition is one of the most important environmental factors contributing to optimum health and vigor throughout life.

It is worthy of mention that among the white children examined during the Public Health Department survey 13.4 per cent were judged to

TABLE 3. A SUMMARY OF THE ADEQUACY OF DIETS CONSUMED BY NEGRO STUDENTS IN EACH OF THE TEN PROTECTIVE FOODS

	NEW ORLEANS SCHOOLS			OTHER SCHOOLS		
	Good	Fair	Poor	Good	Fair	Poor
Milk						
Number	122	359	682	15	63	212
Per Cent	10.5	30.9	58.6	5.2	21.7	73.1
Butter						
Number	63	219	881	3	7	280
Per Cent	5.4	18.8	75.8	1	2.4	96.6
Eggs						
Number	186	314	663	44	90	156
Per Cent	16	27	57	15.2	31	53.8
Lean Meat or Substutute*						
Number	796	229	138	205	56	29
Per Cent	68.4	19.7	11.9	70.7	19.3	10
Green, Leafy, or Yellow Vegetables						
Number	292	312	559	20	73	197
Per Cent	25.1	26.8	48.1	6.9	25.2	67.9
Other Vegetables						
Number	188	253	722	20	41	229
Per Cent	16.2	21.8	62.1	6.9	14.1	79
Potatoes						
Number	93	203	867	29	59	202
Per Cent	8	17.5	74.5	10	20.3	69.7
Whole Grain Cereals						
Number	78	201	884	1	41	248
Per Cent	6.7	17.3	74.5	.3	14.1	85.5
Citrus Fruits, Tomatoes or Raw Vegetables†						
Number	113	163	887	16	41	233
Per Cent	9.7	14	76.3	5.5	14.1	80.3
Other Fruit						
Number	226	210	727	25	53	212
Per Cent	19.4	18.1	62.5	8.6	18.3	73.1
TOTAL DIET						
Number	38	443	682	1	71	218
Per Cent	3.3	38.1	58.6	.3	24.5	75.2

*Lean meat as such must appear in the menu at least four times per week. Meat substitutes include cheese, dried peas or beans, and soybeans.

†The only raw vegetables which may be included in this group are cabbage, green peppers and radishes.

be in "Poor" or "Very Poor" nutritional condition while 24.4 per cent of the negro children examined during the same survey were judged to be in "Poor" or "Very Poor" nutritional status.* Dietary records from children examined in this survey are summarized in Tables 2 and 3 of this paper under the heading "Other Schools."

Practical Recommendations

In order to make satisfactory changes in the food habits of the family, every homemaker must first obtain a general knowledge of the nutritional needs of the individual. This information can be obtained from the College of Agriculture at the Louisiana State University, from the parish Home Demonstration agent, from the Farm Security agent, from local home economics teachers in the public schools, from Red Cross Nutrition classes (if they have been organized in the community), or from the United States Department of Agriculture.

By securing reliable information in regard to proper methods of cooking, the homemaker can reduce losses of minerals and vitamins in cooking and thereby improve the nutrition of the family. This information can be secured from the sources mentioned above.

The homemaker should learn how to get the largest possible nutritional value from the money she can afford to spend for food. She should demand from her grocer enriched foods in the lines where these are obtainable. She should know which foods have a high nutritive value in proportion to their cost.

Many families living in rural areas could well produce their own milk, meat, and eggs and thus secure a more abundant supply of these important foods than their incomes will permit them to buy. Adequate amounts of these foods require a considerable portion of the food money when they must be purchased. If they can be produced at home this money is available for other needs.

Home gardens, where these are possible, carefully planned and properly cared for, can be one of the cheapest and most dependable methods of insuring a supply of fresh vegetables throughout most of the year. In some areas farm orchards are a practical source of fruits.

Where home gardens, orchards, poultry and hogs or cattle are practical, canning of some fruits and vegetables, proper storage of others, canning and curing of meats, home preservation of eggs and possibly home drying of some products should be more commonly practiced to provide an adequate supply of these foods in seasons when they are not available in sufficient quantity or variety in the fresh state. In some communities a canning kitchen or canning equipment are available for a small fee.

School lunches should provide as much protective foods as possible to supplement home diets which are often inadequate in this respect.

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* Margaret Moore—Personal Communication.

POTASH INSTITUTE, INC.

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PEANUTS AS A WARTIME CROP IN LOUISIANA

By

FRANK D. BARLOW, JR., AND GEORGE TOWNSEND

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PEANUTS AS A WARTIME CROP IN LOUISIANA[1]

BY FRANK D. BARLOW, JR., AND GEORGE TOWNSEND[2]

INTRODUCTION

Farmers have been asked to go "all out" in producing peanuts in 1943. The job of growing 5.5 million acres of peanuts has been assigned largely to southern farmers. Louisiana farmers have been asked to grow 75,000 of these acres, an increase of 168 per cent over the acreage harvested in 1942.

To reach the goals set up for Louisiana, some unusually difficult problems are in prospect. Chief among these problems is the fact that in order to grow peanuts other crops must be reduced, crops which in 1942 were generally more profitable than peanuts. To offset this problem, however, the United States Department of Agriculture is preparing to discard the "two price" system for peanuts and to substitute a single price for all peanuts, supported at 80 to 85 per cent of parity. This will result in a price of at least $120 per ton for peanuts. In addition, "incentive payments" are being offered peanut growers. By taking full advantage of "incentive payments," most growers will be able to earn a payment sufficient to cover the cash costs of growing peanuts, up to harvest time.

Higher prices and "incentive payments" promise to make peanuts relatively profitable in 1943. Other difficulties and uncertainties which prevailed in 1942 will be less serious in 1943:

(1) The fact that peanut pickers were made available for harvesting the 1942 crops should remove all uncertainty of being able to harvest the 1943 crop. While some localities were perhaps inadequately served, the experience gained by picker operators, plus the promise that additional new machines will be available, should make for a more satisfactory harvest in 1943.

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[1] Appreciation is expressed for the cooperation and assistance received from 30 farmers in Lincoln, Union, Claiborne, and Bienville parishes who furnished the basic data upon which this report is based. Mr. Dawson M. Johns, Superintendent of the North Louisiana Experiment Station at Calhoun, offered many valuable suggestions particularly with regard to cultural practices. We also gratefully acknowledge helpful suggestions and criticisms given by Professor B. M. Gile and Director W. G. Taggart of the Louisiana Agricultural Experiment Station and Messrs. E. L. Langsford and K. L. Bachman of the Bureau of Agricultural Economics.

[2] Frank D. Barlow, Jr., Associate Economist, Louisiana Agricultural Experiment Station, Department of Agricultural Economics; George Townsend, Associate Agricultural Economist, Bureau of Agricultural Economics, Division of Farm Management and Costs.

(2) The experience of growers with the crop in 1942 uncovered flaws in cultural practices and disclosed production methods which will result in more successful production.

(3) The problem of developing enlarged local market facilities and arrangements is inevitably difficult. The experience gained in marketing the 1942 peanut crop can reasonably be expected to result in a more efficient marketing organization in 1943.

This report presents an appraisal of farmers' experience with peanuts in 1942 and analyzes the possibilities of growing the crop profitably in 1943. Comparisons have been made between prospective returns to be obtained from peanuts, cotton, and corn under different yield and price situations. Illustrations are given and suggestions are offered to assist the individual farmer in determining how many acres of peanuts he can grow profitably. The final section outlines the cultural practices essential for growing peanuts successfully. Although the report is based upon data obtained in the North Louisiana Upland Cotton Area, the conclusions are applicable to most hill sections of the State. It is believed that this information will be of assistance to farmers and professional agricultural workers who are faced with the important but difficult job of producing 75,000 acres of peanuts in 1943.

WARTIME NEEDS

The appeal for increased production of peanuts is part of a broad national program designed for increasing the total supply of fats and oils to meet the Nation's wartime needs. Estimates indicate that essential uses of fats and oils will total 13.8 billion pounds in 1943, even with curtailed civilian consumption as provided by the recent "general limitation order" applying to the use of these materials. If a reserve as large as that recommended by the Food Requirements Committee is to be accumulated by the end of the year, a total supply of 15.3 billion pounds will be required in 1943. The estimated reserves on hand at the beginning of the year plus possible imports total only 2.8 billion pounds, leaving about 12.5 billion pounds to be obtained from domestic production. This is about 33 per cent more than the amount produced in 1941 and 60 per cent more than the average production during the five-year period 1936-40.[3]

To supply the minimum needs for fats and oils in 1943 almost three billion pounds will have to be obtained from the three main oil-bearing crops—flaxseed, soybeans, and peanuts. Processing, transportation, and other difficulties place definite limits on the extent to which the production of oils from flaxseed and soybeans can be increased. Therefore, it is anticipated that at least 5.5 million acres of peanuts will be needed in 1943.

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[3] See the October, 1942, and the December, 1942, issues of *The Fats and Oils Situation* for more detailed discussion.

Peanuts versus cotton for oil production: Many farmers, knowing that cottonseed is an important source of vegetable oil, find it difficult to understand why cotton production should be restricted at a time when oil is badly needed. The following considerations afford a partial explanation of why emphasis has been placed on peanuts:

(1) Peanut oil is considered superior to cottonseed oil for edible purposes, topping the list of all vegetable oils in many key food values. Moreover, peanut oil is adapted to a wider variety of industrial uses. This preference is borne out by the usual price differential in favor of peanut oil.

(2) Farm land suited to peanut production generally produces cotton of the shorter staple lengths, and supplies of these shorter staples are in excess of visible needs for the next year or two.

(3) Probably the most important consideration, in view of the shortage of labor and fertilizer, is the fact that equal outlays will ordinarily produce more peanut oil than cottonseed oil. For example, with a production of 250 pounds of lint cotton an acre, about 64 pounds of oil can be obtained from the seed, whereas a yield of only 213 pounds of peanuts would produce the same amount of oil. On soils suitable for peanuts in the Louisiana Upland Cotton Area, the amount of fertilizer and labor necessary for obtaining a cotton yield of 250 pounds should produce at least 700 pounds of peanuts, or about 200 pounds of oil. Comparative yields of cotton and peanuts necessary to provide the same amount of oil per acre are presented in Table 1.

TABLE 1. YIELDS OF COTTON AND PEANUTS NECESSARY TO PROVIDE THE SAME AMOUNT OF OIL PER ACRE.

CRUDE OIL YIELD PER ACRE	YIELD OF COTTON AND PEANUTS NECESSARY FOR INDICATED YIELD OF OIL		
	Cotton*		Peanuts unshelled†
	Seed and lint	Lint	
Pounds	*Pounds*	*Pounds*	*Pounds*
50	515	195	167
100	1,031	392	333
150	1,546	587	500
200	2,062	783	667
300	3,093	1,175	1,000

*Based upon 38 per cent lint turnout and 15.6 pounds of oil per 100 pounds of cottonseed.
†Based upon 30 pounds of oil per 100 pounds ot peanuts.

EXPERIENCE WITH PEANUTS IN 1942[4]

The outcome of the 1942 crop does not afford an adequate test of peanuts as a wartime farm enterprise in North Louisiana. However, a review of farmers' experience with the crop is useful in evaluating 1943 peanut production possibilities.

Some of the problems in producing peanuts in 1942 were: difficulties in obtaining a good stand; incomplete knowledge of the crop's cultural requirements; an unusually wet growing season, which often prevented timely and adequate cultivation, and which, combined with a shortage of labor, forced some farmers to abandon part or all of their peanuts; and, misgivings concerning the availability of peanut pickers and the adequacy of market outlets. These and other problems, contributed to, and have tended to be exaggerated by the low financial returns that many growers realized from peanuts. The fact that Louisiana farmers carried an estimated 28,000 acres of peanuts through to completion in the face of the difficulties encountered is ample proof of their unreserved patriotism.

Cash returns from peanuts: Most farmers sold their peanuts for $84 a ton, delivered in sacks at the buying point. At this price the returns from peanuts compared very unfavorably with cotton, the standard by which most farmers judge alternative crops in this area. On the farms surveyed, peanuts yielded an average of 500 pounds of nuts and 720 pounds of hay per acre, bringing a gross return of $24.60, which includes an allowance of $10 per ton for hay. Direct cash costs for peanuts, exclusive of hired labor, averaged $9.66, leaving a net cash return of $14.94 per acre available to the operator as payment for about 54 hours of labor and the use of his workstock, equipment, and land (Table 2). In contrast, cotton yields on these same farms averaged 226 pounds of lint and 340 pounds of seed, bringing a gross return of $49.64 per acre. Direct cash expenses for cotton, excluding cash wages, amounted to $7.36 per acre, leaving a net cash return of $42.28 as payment for about 80 hours of work and other unallocated charges for the use of workstock, equipment, and land (Table 3).

Although the cash returns from peanuts in 1942 did not compare favorably with the returns from cotton, farmers who planted peanuts as a supplemental enterprise and primarily from patriotic motives had little cause for dissatisfaction at the outcome if they obtained average, or better than average yields (Table 2). Over one-third of the farmers included in this study, however, obtained yields of less than 400 pounds of nuts per acre, and several of these failed to recover direct cash costs. The average yield obtained by this "least successful group" was 289 pounds of nuts per acre. With production at this level, the tenant who rented land on the customary "third and fourth" basis realized only $5.00 per acre for his time and the use of equipment.

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[4] In November, 1942, a survey was made of 30 farmers in Lincoln, Union, and Claiborne parishes. The area is considered to be a good cross-section of the best peanut producing area of the State. The data obtained probably describe an average situation more favorable to peanut production than actually existed in 1942. The early date of the survey tended to include the more successful growers because it was easier for these farmers to obtain picking facilities and thus complete harvesting and marketing earlier than the growers with smaller production and lower yields.

TABLE 2. CASH RETURNS AND DIRECT CASH COSTS PER ACRE OF PEANUTS, NORTH LOUISIANA UPLAND COTTON AREA, 1942.

ITEM	Unit	Price per unit	FARMS WITH HIGH YIELDS[1]		FARMS WITH LOW YIELDS[2]		AVERAGE ALL FARMS	
			Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Production—average								
Nuts	pounds	$ .042	731	$30.70	289	$12.14	500	$21.00
Hay	tons	10.00	.50	5.00	.23	2.30	.36	3.60
GROSS VALUE		......	......	35.70	......	14.44	......	24.60
Direct cash costs[3]								
Fertilizer	cwt.	$ 1.50	1.8	$ 2.70	1.2	$ 1.80	1.5	$ 2.25
Seed	bu.	1.75	1.3	2.28	1.3	2.28	1.3	2.28
Sacks	number	.12	12.0	1.44	5.0	.60	8.0	.96
Nails	pounds	.08	.9	.07	.8	.06	.8	.06
Picking	bu.	.13	24.3	3.16	9.6	1.25	16.7	2.17
Baling	bale	.10	20	2.00	9.3	.93	14.4	1.44
Hauling to market	ton	2.00	.36	.72	.14	.28	.25	.50
TOTAL		......	......	$12.37	......	$ 7.20	......	$ 9.66
Returns over direct cash costs[4]		......	......	$23.33	......	$ 7.24	......	$14.94

[1] Average of farms reporting a yield of 600 pounds of nuts per acre, or higher.

[2] Average of farms reporting a yield of less than 400 pounds of nuts per acre.

[3] All hired labor costs are excluded.

[4] Gross value of the crop, less the specified cash expenses. This is the amount available to the operator for paying wages to himself and others, and for the use of workstock, equipment, land, etc.

Competition of peanuts with other crops: Peanuts in 1942 in Louisiana not only yielded less return per acre than cotton but also less than most other crops commonly grown in the area. Another important consideration is the fact that the peak labor requirements for peanuts coincide in timing with those of cotton, and to some extent with those of corn and other crops. Because of this competition between peanuts and other crops for the use of available labor, an evaluation of peanuts in terms of relative returns per man hour of work is perhaps the most practical way to measure the competitive position of the crop (Table 3). This is especially true in wartime when farm labor is scarce. With 1942 yield and price relationships, peanuts rated a poor third as an alternative when compared with cotton and corn.

The per acre returns over direct cash costs were more than twice as large for cotton as for peanuts. Relative returns per hour were also much higher for cotton. Although cotton yields in the area were somewhat higher than normal in 1942, the returns indicate that it is not profitable to substitute peanuts for cotton when cotton is 18 to 19 cents a pound and peanuts are $84 a ton.

TABLE 3. COMPARISON OF RELATIVE RETURNS OVER DIRECT CASH COSTS FOR PEANUTS, COTTON, AND CORN, AVERAGE OF FARMS REPORTING, NORTH LOUISIANA UPLAND COTTON AREA, 1942.

	Peanuts	Cotton	Corn
Yields	Nuts 500 lb. Hay .36 ton	Lint 226 lb. Seed 340 lb.	Grain 10.8 bu.
Average price	Nuts 4.2c lb. Hay $10.00 ton	Seed $47.40 ton Lint 18.4c lb.	Grain $1.00 bu.
Gross cash value per acre	$24.60	$49.64	$10.80
Direct cash costs per acre[1]			
Fertilizer	$ 2.25	$ 3.51	$ 1.34
Seed[2]	2.28	.77	.13
Peanut picking	2.17	......	......
Baling hay	1.44	......	......
Ginning, bagging and ties	......	2.42	......
Supplies	1.02	.21	......
Hauling to market	.50	.45	......
TOTAL	$ 9.66	$ 7.36	$ 1.47
Returns over direct cash costs per acre[3]	$14.94	$42.28	$ 9.33
Man hours labor per acre	54.1	79.5	24.4
Returns over direct cash costs per hour of man labor[4]	$ .28	$ .53	$ .38

[1] All hired labor costs are excluded.

[2] Cash or cash equivalent. Include both purchased and farm grown seed.

[3] Gross value per acre less value of farm grown seed and direct cash cost. This is the amount available to the operator for paying wages to himself and others and for use of workstock, equipment, land, etc.

[4] This does not represent the actual return to labor as such, but is a relative measure of profitableness.

It is more difficult to evaluate the competitive position of peanuts with corn. Corn is grown primarily for feed, and part of its value is derived from its use as fall pasture. With corn valued at $1.00 a bushel in 1942, the per acre returns over direct cash costs were $5.61 less than for peanuts. However, when total labor requirements are considered for the two crops, the relative returns per hour of man labor were less for peanuts than for corn (Table 3).

Some farmers had sufficient labor and idle cropland to handle their peanut acreage over and above their customary acreages of other crops, and in this situation any net cash returns that were realized from peanuts represented an addition to the net farm earnings. On the other hand, many farmers found it necessary to curtail production of cotton in order to have labor available for peanuts, and most of these farmers reduced their net farm earnings to the extent that peanuts replaced cotton. On the farms studied, 42 per cent of the acreage of peanuts was on land that otherwise would have been idle, 32 per cent on land that would have been used for cotton, and 18 per cent on land that would have been used for corn.

PEANUTS AS AN ALTERNATIVE IN CROP ORGANIZATIONS[5]

The production of peanuts is not an enterprise which is entirely new to many Louisiana farmers. During World War I peanuts were found to be quite profitable. Again, during the "cotton boll weevil period" of the 1920's peanuts were more profitable than cotton and attained considerable commercial importance, even though prices were much below wartime levels. With the development of boll weevil control, however, farmers returned to cotton production and the commercial production of peanuts receded to a place of minor importance.

The typical crop organization in the Upland Cotton Area at present is centered around cotton as the major cash crop. Some farmers grow a few acres of truck crops while others are beginning to supplement the cropping system with a livestock program, but even on these farms cotton continues to be the main cash crop. Cotton for many years has been the primary source of farm income and farmers are reluctant to decrease cotton acreage further than has already been made necessary by labor shortages. Given a program which will raise the returns from peanuts to a level competitive with cotton, however, and with one year of experience behind them, it is likely that many farmers in the area will find a prominent place for peanuts in their 1943 farm plans.

Income possibilities: Peanuts offer promising income possibilities in 1943. The appraisal of farmers' experience with peanuts in 1942 is not an indictment against the crop because the situation appears likely to be different in 1943 in several respects. A price support of $120 per ton has been recommended for all peanuts in 1943 regardless of whether they are used for oil or for edible purposes. This compares with the price of $84 per ton for oil peanuts in this area in 1942. Cotton yields were above average this year. The 1938-41 cotton yield for the Louisiana Upland Cotton Area was 175 pounds as compared with the yield of 226 pounds reported by farmers in this survey. Approximately one-third of the peanut growers included in the survey obtained good yields of 600 pounds of nuts per acre and over. Furthermore, experimental evidence conclusively supports the assertion that yields of 600 pounds can be obtained and probably exceeded with suitable soil and reasonably good production practices.

The individual farmer is interested in knowing how the income he may obtain from peanuts compares with other crops. Table 4 has been prepared for this purpose and presents the relative returns from peanuts, cotton, and corn at different yields and prices. The different prices are those which have prevailed in recent years or are in prospect for 1943, although conditions necessary to bring about the highest price shown for each crop would possibly also result in higher production costs.

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[5] In this analysis of peanuts as a farm enterprise it has been assumed that the need for producing a large acreage of peanuts would not extend over any long period of years. Hence the rather serious implications of soil depletion which would result from continuous peanut production have been ignored.

TABLE 4. Relative Returns per Acre and per Man Hour of Man Labor from Peanuts, Cotton, and Corn with Different Yields and Prices, North Louisiana Upland Cotton Area.*

Price per ton	Peanut yields per acre							
	300 pounds		500 pounds		700 pounds		900 pounds	
Dollars	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*
76	8.02	16	12.94	24	16.40	26	21.45	31
84	9.22	18	14.94	28	19.90	31	25.95	37
100	11.62	23	18.94	35	25.50	40	33.15	47
120	14.62	29	23.94	44	32.50	51	42.15	60
130	16.12	31	26.44	49	36.00	56	46.65	66

Price per lb.	Cotton yields per acre							
	150 pounds		190 pounds		230 pounds		270 pounds	
Cents	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*
16	23.37	33	29.60	38	36.24	45	42.87	52
17	25.11	36	31.50	41	38.90	49	45.99	55
18	26.84	38	33.70	44	41.56	52	49.11	59
19	28.58	41	35.89	47	44.22	55	52.24	63
20	30.31	43	38.09	49	46.88	59	55.36	67

Price per bu.	Corn yields per acre							
	8 bushels		10 bushels		12 bushels		14 bushels	
Dollars	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*	*Dollars per acre*	*Cents per hour*
.80	5.28	22	5.88	24	6.96	28	8.06	33
.90	6.08	25	6.88	28	8.16	33	9.46	38
1.00	6.88	29	7.88	32	9.36	38	10.86	44
1.10	7.68	32	8.88	36	10.56	43	12.26	50
1.20	8.48	35	9.88	40	11.76	48	13.66	56

*The returns per acre and per man hour of labor are only a relative measure of the profitableness of the three enterprises because farm overhead and other unallocated costs have not been taken into account. The estimates are based on the gross value per acre (including an allowance for peanut hay and cottonseed) less estimated direct cash costs for all supplies and services except hired labor. Thus the returns represent the net amount available for payment of wages, use of workstock and equipment, interest on investment, and land rent. Incentive payments earned on peanuts would be in addition to the returns calculated above.

In comparing the relative returns from these three crops, as presented in Table 4, it will be noted that for each price and yield situation the returns are expressed as "relative returns per acre" and "relative returns per hour." The relative returns per acre are based on the cost data shown in Table 3, and no allowance has been made for labor costs or overhead items of expense such as interest, workstock and equipment costs, and land rent. Thus the relative returns per acre are an approximation of the amount that the grower will have available to allocate to labor and with which to meet his overhead costs. The relative returns per hour were calculated by dividing the returns per acre by the number of hours of work ordinarily used per acre. Hence the returns per hour are only a relative measure by which the profitableness of these crops can be measured.

To illustrate the use of Table 4, assume that it is desired to compare the returns from peanuts yielding 500 pounds and cotton yielding 190 pounds with prices of $120 a ton and 18 cents a pound respectively for the two crops. Reading down from the peanut yield of 500 pounds, a return of $23.39 per acre or 44 cents per hour is found opposite the price of $120 per ton. Likewise, with cotton a yield of 190 pounds provides a return of $33.70 per acre or 44 cents per hour when the price of lint cotton is 18 cents a pound. With these assumptions, cotton will provide a return of $10.61 per acre higher than peanuts, but the returns are about the same per hour of time spent on each of the two crops. For the farmer who had unused land, peanuts in this case would be equally as profitable or possibly more profitable than cotton for an equal amount of work because with the same labor supply, about one-third more acres of peanuts could be grown than cotton. In this substitution of peanuts for cotton unused crop-land would be put to a productive use.

Incentive payments for peanuts: Incentive payments will be made to farmers to assist them in producing the maximum amounts of essential farm products in 1943. For peanuts, a payment of $30 an acre will be made for each acre in excess of 90 per cent and up to 110 per cent of the farm goal. This assistance, which is in addition to price supporting measures, is being offered to compensate farmers for higher production costs in achieving increased goals, and to aid new producers.

Because the amount of payment that a farmer can earn is based on his individual farm goal, it is important for him to analyze his farm plans for 1943 in relation to this fact. The object should be to develop goals that approximate the maximum that can be achieved. By meeting his peanut goal a farmer will be eligible for a payment which is the equivalent of $3 an acre for each acre of peanuts. If the grower can increase his peanut enterprise to an acreage 10 per cent larger than his goal he will be eligible for a payment equivalent to $5.45 for each of the total number of acres of peanuts. On the other hand, if his peanut acreage is 10 per cent less than his goal the farmer will not be eligible for any payment. Moreover, if less than 90 per cent of his goal is planted the grower will be subject to a penalty in the form of a deduction from certain A. A. A. payments. The penalty amounts to $15 an acre for each of the number of acres by which the planted acreage falls short of the goal. Thus, if a farmer's goal is 10 acres of peanuts and he plants only eight acres, he would be subject to a penalty of $15.

By taking full advantage of the incentive payment program, it will be profitable to produce a larger acreage of peanuts than would otherwise be possible. Since the number of acres which qualify for payment are to be calculated as a percentage of the farm goal, it is apparent that the larger the goal the larger will be the number of acres qualifying for payment. For example, the maximum payment that can be earned with a peanut goal of four acres will be $24, whereas, with a 10-acre goal a maximum payment of $60 can be earned by producing 11 acres of peanuts.

If the maximum incentive payment is earned, the competitive position of peanuts will be greatly increased as compared with the possible earnings from cotton and other crops. With a yield of 700 pounds, the maximum payment is the equivalent of a price increase amounting to over $15 a ton. With reference to the estimates given in Table 4, it should be noted that earning the maximum payment will add $5.45 to the relative returns per acre of peanuts, and about 10 cents to the relative returns per hour. Farmers who find it impractical to earn the maximum payment should add proportionately smaller amounts in evaluating the possible returns from peanuts.

Man labor requirements for producing peanuts, cotton, and corn: More hours of work are required to grow an acre of cotton than an acre of peanuts. The efficiency with which labor is used in producing crops is important in determining the total acreage of crops the farmer can handle, as well as influencing his net returns. The usual operations and average amounts of labor used for producing peanuts, cotton, and corn are presented in Table 5. It should be noted that the production practices recommended in the final section of this report require about the same amount of time for producing an acre of peanuts as was used in 1942 on the farms studied. (See Table 6, page 19.) The individual farmer can compare the time he spends per acre with these average requirements as a check on his efficiency. Adjusted to conform with his individual abilities, this type of data is useful in planning to meet the labor needs of his particular crop organization.

The hours of work required to produce 10 acres of cotton, peanuts, and corn are shown by months in Figure 1. This distribution of labor requirements reveals a direct conflict between cotton and peanuts—that is, peak labor requirements for both crops occur at about the same time. Farmers in the area have found that staggering the peanut planting dates will help overcome this conflict. In 1942 most growers planted part of the peanut crop around the first of May and the remainder about the first of June. By extending planting dates from the middle of April and up to June 15, early peanuts can be dug prior to the first cotton picking, and the late planted peanuts can be dug between the first and second picking of cotton around October 1.

How many acres of peanuts can a farmer afford to grow?: The direct conflict between peanuts and cotton for the use of labor during cultivation and harvest means that any substantial increase in peanuts would involve a reduction in cotton. By careful planning of planting dates with an eye to harvest time, however, most farmers have sufficient land and labor to handle three to four acres of peanuts. Peanut production, even on this small scale, will definitely add to farm earnings—particularly, if the grower is able to handle the crop with his own labor. The production of more than four acres of peanuts with reasonable prospects of realizing a profit represents a problem that each farmer will have to solve in the light of his particular set of circumstances.

TABLE 5. USUAL OPERATIONS, AND MAN LABOR USED PER ACRE IN PRODUCING PEANUTS, COTTON, AND CORN, NORTH LOUISIANA UPLAND COTTON AREA, 1942.[1]

USUAL OPERATION	PEANUTS		COTTON		CORN	
	Times done	Man hours per acre	Times done	Man hours per acre	Times done	Man hours per acre
Seed bed preparation	1–2	5.5	1–2	5.7	1	5.4
Streak-off, open row or harrow	1	1.0	1	1.1	1	1.1
Fertilize	1	1.0	1	1.6	1	1.3[2]
Plant	1	5.2	1	1.4	1	1.1
Cultivate	3–5	10.0	4–6	13.0	4–6	9.2
Hoe	1	6.4	1–2	12.5	1	2.2[3]
Harvest	...	25.0[4]	2	44.2[5]	1	4.1[6]
TOTAL		54.1		79.5		24.4

[1] Average for farms reporting.

[2] Side dressing.

[3] Thinning.

[4] Includes time spent putting up poles, nailing on slats, digging, and stacking, picking, baling, and marketing. Contract labor furnished by the picker and baler operator amounted to 4.6 man hours per acre and is excluded from this total.

[5] Includes picking labor and time spent loading and hauling to gin.

[6] Includes pulling corn and hauling into barn.

Even though many farmers have sufficient labor to work all of their crop-land, some has been left idle because of a small cotton acreage allotment, or for other reasons. Peanuts afford a very favorable means of utilizing these unused resources profitably. By careful planning, many farmers in this situation may find that from five to seven acres of peanuts or perhaps even more can be handled profitably.

Labor shortages may prevent complete utilization of all cropland on some farms in 1943. The production of more than three to five acres of peanuts on these farms represents a complex problem—but even then, a larger acreage of peanuts may be feasible and profitable. When prices for 1943 are announced it will be easy to compare the profitableness of different crops at different yields (see Table 4). Reasonable yields should be estimated by each farmer in order to compare the relative returns from each crop at 1943 prices. If he finds that he has some land which, if used for peanuts instead of cotton, will provide the same or higher *relative returns per hour* worked it is fairly certain that growing peanuts on this land, even to the extent of reducing cotton acreage, will be profitable.

USUAL DISTRIBUTION OF THE HOURS OF MAN LABOR REQUIRED TO GROW AND HARVEST TEN ACRES EACH OF COTTON, PEANUTS, AND CORN.

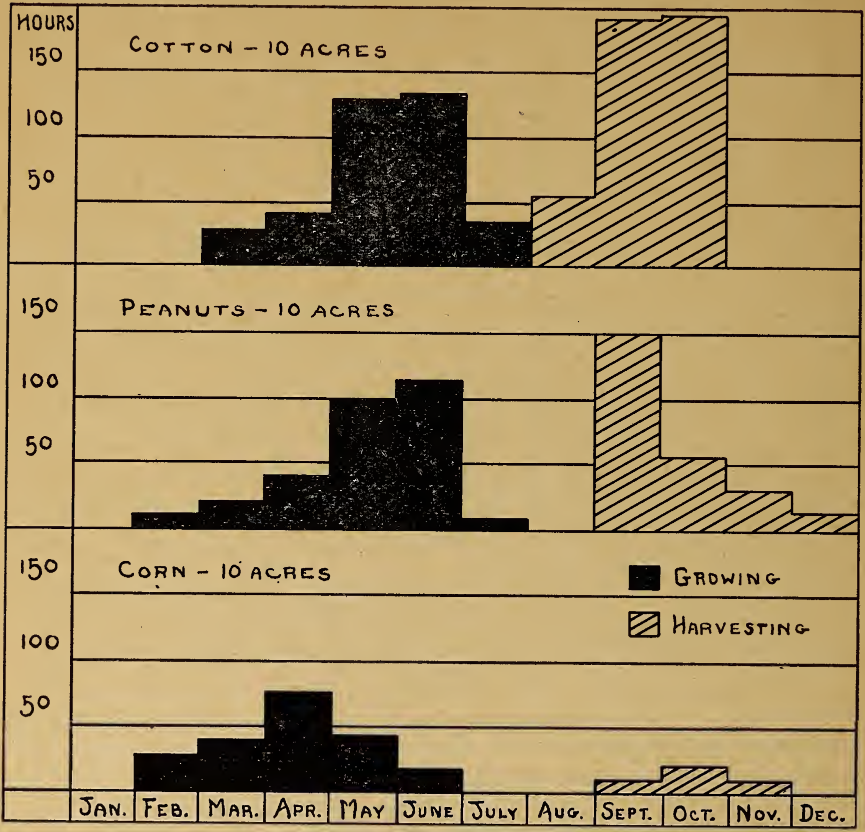

FIGURE 1. Approximately one-third more labor is required to grow cotton than peanuts. Labor required to grow peanuts coincides in timing with that required to grow cotton and most other crops. The conflict between peanuts and cotton becomes important in growing the crop during May and June, but the peak requirements occur during cotton picking and peanut digging in September. By extending planting dates for peanuts from early in April until June 15 there is an opportunity for farmers to spread the digging period from the last of August to October which would reduce the peak load at harvest time.

As peanuts require approximately one-third less man hours per acre than cotton, about six acres of peanuts can be handled with the same labor required to produce four acres of cotton. Hence, by shifting to peanuts the farmer with a "short" labor supply can make more complete use of his cropland. Moreover, the shift from cotton to peanuts will have reasonably good possibilities of increasing the farm operator's total income, providing the yield-price relationship affords at least equal returns per hour of work from each of the crops.

Although the foregoing discussion of how many acres of peanuts a farmer can afford to grow is concerned mainly with the "family" size farm which predominates in the area, the same considerations are applicable to the larger farm units which may have several tenant or wage families.

Prospective peanut growers, both large and small operators, must consider the matter of obtaining custom picking services. In communities where there is sufficient acreage of peanuts to warrant the setting up of pickers within a reasonable distance from the individual farm, growers of small acreages will likely find it feasible to obtain mechanical harvesting. On the other hand, the isolated grower must consider his farm plan in light of getting the peanuts picked. If sufficient labor and land are available to this type of grower, it may be advantageous for him to grow an acreage large enough to justify a picker coming to his farm to serve him individually. If this is not feasible and the cost of hauling to a central point will absorb his profit, the isolated grower will probably do well to limit his peanut acreage to that which can be hand picked.

PRODUCTION PRACTICES THAT HAVE PROVED SUCCESSFUL[6]

The experience of farmers who grew peanuts in 1942 shows that it requires almost as much work and expense to produce a poor yield as it does to produce a good yield. Hence, when prices are fixed, the grower's margin of profit or loss is largely governed by the yield. The practices outlined below are believed adequate for obtaining a yield of at least 700 pounds of nuts—barring a poor season and other crop hazards. These practices were carried out by successful peanut growers in North Louisiana in 1942 and resulted in yields considerably higher than 700 pounds. Similar practices followed by experienced growers in other parts of the South have resulted in yields much higher than 700 pounds per acre. The practices, however, are recommended for the Spanish variety of peanuts, and are not applicable in all respects to other varieties.

Choice of land: Best results are obtained with peanuts when they are planted on well-drained light sandy loam soils. Poorly drained or sour soils are not desirable. As is true of most crops, the more fertile the soil the greater the expected yield of peanuts might be. To plant peanuts on land that is considered unsuitable for other crops is inviting failure. As a precaution against excessive erosion, the site selected for planting peanuts should be reasonably level. Peanuts should not be planted on the same land two years in succession because of excessive soil depletion and the danger of soil borne diseases. A three-year rotation is recommended for peanut growing.

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[6] This section is based upon information secured from a few successful peanut growers in North Louisiana, results obtained from the experimental work on peanuts at the North Louisiana Agricultural Experiment Station, and general information presented in the Mississippi State Agricultural Experiment Station, Bulletin No. 366, *Peanut Production,* compiled by H. O. West, March, 1942.

Land preparation: Thorough preparation of the land before planting is necessary for obtaining a satisfactory stand and will reduce the amount of time later required for cultivation. Flat breaking and dragging, or harrowing, the land level is generally preferable to bedding. However, if adequate drainage is questionable, bedding the land is desirable.

The land should be free of trash and stalks at planting time since stalks interfere with cultivation and harvesting. When winter cover crops are not grown the practice of cutting stalks during the winter by light disking is considered less conducive to erosion. In most of the Upland Cotton Area, light disking during the winter is preferable to deep mid-winter plowing. Spring plowing to a depth of four to six inches about six weeks before planting should be sufficient seedbed preparation.

Fertilizer: Benefits obtained from fertilizer vary widely. Experimental evidence suggests that if land is naturally fertile, or if it has been heavily fertilized during the preceding year, peanut yields will not be increased appreciably by fertilizer. However, it is probable that much of the peanut acreage in 1943 will be planted on land that received little or no fertilizer in 1942. In this case, the application of about 200 pounds per acre of a complete fertilizer will do much toward insuring a good yield and the maintenance of soil fertility. A mixture which is low in nitrogen, such as 3-12-6 or 4-10-7 is generally recommended for Louisiana farmers. Results at the North Louisiana Experiment Station in 1942 indicated that an application of 200 pounds of 3-8-8 fertilizer per acre was most satisfactory, but since 3-8-8 will likely not be available in 1943, the 3-12-6 mixture is recommended for general use. In North Louisiana 4-8-4, which is almost standard, is more expensive but is less satisfactory for peanuts than for other crops. Side dressing with nitrate of soda is expensive and is likely to be more harmful than beneficial.

The use of lime is controversial. Experiments indicate that if soils are only slightly acid to neutral no benefit can be expected from lime. If the soil is excessively acid—and this can be determined properly only by testing—an application of around 500 pounds of lime will probably pay.

Fertilizer should be applied a few days ahead of planting and should be well mixed with soil to prevent the seed from coming in contact with the fertilizer. The use of a regular fertilizer distributor is adequate precaution.

Seed preparation and planting: All other precautions against a poor yield are of no value unless a good stand is obtained. The first requirement for obtaining a good stand is to select good sound planting seed which is free of trash and defective nuts. The seed should have been dug when the nuts were matured properly and should have been well cured and stored. Seed which have been allowed to heat are not likely to germinate. If stored properly, however, seed two or three years old can be safely used. Considerable evidence indicates that shelled seed of the Spanish variety do not germinate better, and perhaps not as well as seed handled otherwise. Cracking or simply breaking the pods into two pieces will hasten germination about as well as complete shelling and with a considerable saving of labor. Good stands can be obtained, however, by planting unbroken or unshelled seed which have been soaked in water over night.

The second requirement for obtaining a good stand is to plant ample quantities of seed. Enough seed should be used to produce a plant every four to six inches in the rows. Highest yields have been obtained with this spacing and with the rows 24 inches apart. In an experiment conducted at Lauderdale, Mississippi, on Ruston loamy sand soils during the two-year period, 1940-41, an average yield of 1,497 pounds was obtained on 24-inch rows, as compared with 1,158 pounds on 30-inch rows, and 593 pounds on 36-inch rows.[7] A similar experiment conducted at the North Louisiana Agricultural Experiment Station in 1942 also indicated that highest yields can be expected on 24-inch rows. However, 24-inch rows complicate cultivation and require an extra amount of work and additional planting seed. Where labor is the scarce factor and cropland is idle, these disadvantages of 24-inch rows appear to offset the advantage of higher yields. Many practical growers find that 30-inch row widths with four to six inch spacing is satisfactory. About 45 pounds of unshelled nuts are required to plant an acre with four to six inch spacing on 30-inch rows.

Whether the land has been flat broken or bedded, it should be worked with a drag or harrow before distributing the fertilizer and planting in order to make the bed firm and to kill small weeds and grass. In planting, a short straight shovel may be used to open the furrow and may be attached to a fertilizer distributor or Georgia stock. Labor is saved and a more uniform stand is obtained if a planter is used. A suitable plate may be adapted if a special peanut plate is not available. However, satisfactory results can be obtained by careful hand planting. Seed should be covered to a depth of about two inches. Peanuts may be planted from the time the weather becomes warm and settled (about the first of April to June 15 in North Louisiana). This wide range of planting dates is significant because it provides an opportunity to reduce serious labor problems at harvest time by "staggered" plantings.

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[7] Mississippi State Agricultural Experiment Station Bulletin No. 366, compiled by H. O. West, March, 1942.

Cultivation: Peanuts require timely and thorough cultivation. According to successful growers, cultivation should begin when the peanuts first come through the ground. The first cultivation should be given with any one of several types of harrows. Either a weeder or a light section harrow is desirable, as they enable the grower to cover a large acreage rapidly. Farmers with neither of these pieces of equipment can obtain good results with an ordinary "gee whiz" by removing the center tooth and straddling the furrow. If the peanuts are planted in a furrow that was opened by a straight shovel ("scooter" point), the young plants will not be damaged by harrowing although sufficient dirt is thrown into the furrow to smother small grass and weeds. Young peanut plants, at this stage of growth, can be covered almost completely without hindering their growth. Because peanuts can be more easily and thoroughly cultivated without damage when the plants are young than at late stages, the first cultivations with a harrow (any of the three types) are paricularly important. Harrowing should be done two or three times at five to eight day intervals, depending on conditions during the growing season.

The last cultivation with the harrow should be followed with a heel sweep (or scrape). Baring-off, which is a practice of questionable merit for any crop unless practically lost in grass, should be "outlawed" for peanuts. Probably two or three side cultivations with a heel sweep, using a scooter point as a lead plow, and followed by sweeping out the middle will be adequate cultivation.

Peanuts might require hoeing after the first plowing with a heel sweep. If, however, the first cultivations with the harrow have been done properly and at the right time, hoeing labor will be reduced to a minimum or may be unnecessary.

Digging: Digging peanuts at the proper time is important. As the nuts form almost continually during the growth of the plant, inevitably there are always immature nuts. The objective is to dig the crop at a time when the maximum number of matured nuts can be obtained, and this stage will have been reached when not more than one peanut per bunch has sprouted. When the leaves begin to turn brown and fall off the plants, the crop is about ready to dig and should be examined daily until the first sprouted peanut is observed.

Maturity is indicated by a darkening of the inside of the shell and discoloration of the veins. If peanuts are not dug within a period of 10 days from the time they are "ready," an excessive number will sprout, thereby reducing the grade and sales value, and also, the nuts become separated from the vine, which results in complete loss. On the other hand, peanuts dug too early will have an excessive number of shriveled kernels which also reduces the weight and sales value. Because of the importance of timeliness in digging peanuts, successful growers plan their peanut planting dates so that they will not have a larger acreage to harvest at any one time than their labor supply can accommodate. By staggered plantings, the peak labor period of harvesting can be spread for optimum convenience.

TABLE 6. RECOMMENDED OPERATIONS, MAN AND MULE LABOR REQUIRED TO GROW AN ACRE OF PEANUTS COMPARED WITH TYPICAL OPERATIONS AND LABOR REQUIREMENTS IN 1942, NORTH LOUISIANA UPLAND COTTON AREA.*

OPERATION	Times over	TOTAL TIME PER ACRE					
		36″ rows 500# yields		30″ rows 700# yields		Average 1942 500# yields	
		Man hours	*Mule hours*	*Man hours*	*Mule hours*	*Man hours*	*Mule hours*
Prepare and plant							
Stalk disposal	1	2.0	4.0	2.0	4.0	....	....
Break	1	6.0	12.0	6.0	12.0	5.5	7.6
Apply fertilizer	1	1.5	1.5	1.8	1.8	2.0	2.0
Plant†	1	1.5	1.5	1.8	1.8	5.2	1.7
TOTAL		11.0	15.0	11.6	19.6	12.7	11.3
Cultivate and hoe							
Harrow	3	4.5	4.5	5.4	5.4	....	....
Side plowing	2	6.0	6.0	7.2	7.2	10.0‡	10.0‡
Run cut middle	1	1.5	1.5	1.8	1.8	....	....
Hoe	1	6.0	....	6.0	....	6.4	....
TOTAL		18.0	12.0	20.4	14.4	16.4	10.0
Harvest							
Dig	1	1.5	3.0	1.8	3.2	1.5	3.0
Set poles and stack	..	18.5	....	23.3	....	18.6	....
Pick nuts	..	3.0	3.0	4.2	4.2	3.8	3.5
Handling hay	..	1.0	.5	1.4	.7	....	....
Market	..	1.0	....	1.0	....	1.1	....
TOTAL		54.0	33.5	63.7	42.1	54.1	27.9

*These operations are not represented as being ideal production practices but are recommended after recognizing the limitations of available equipment on most upland farms.

†Excluding time spent for preparing seed or dropping by hand in recommended operations. In 1942, dropping nuts by hand was included in time required for planting.

‡Total hours spent on cultivation, regardless of specific operation.

Digging is usually done by "lifting" the nuts out of the ground with a turning plow from which the mould board has been removed. The use of a peanut point instead of the regular point will make digging easier, but is not necessary.

Curing and storing: The usual, and probably the safest, method of handling peanuts after they are dug is to stack the vines around the poles. The poles are set about 18 inches in the ground and cross sticks are nailed to the poles about 18 inches above the ground. After being dug, the vines are allowed to wilt for one to three hours which facilitates shaking the dirt off the peanuts and makes stacking on the pole easier. With the cross pieces as supports, the vines are stacked around the pole with the nuts on the inside of the stack. The finished stack should be from three to five feet wide and six to seven feet high. Larger stacks prevent the proper circulation of air which is necessary for curing. The number of poles needed will vary with the production; a "rule of thumb" guide is *one pole for each one and one-half bushels of nuts.* The stack should be "capped" with grass to prevent water damage to the vines and nuts. If properly stacked, the peanuts will keep in the stack for two months or longer, without damage to the nuts, although the hay may become somewhat discolored after six weeks. Peanuts stacked in this manner should be allowed to cure for four to six weeks before picking.

Some growers have found it feasible to shake and windrow the peanuts, allow them to cure two to four weeks, and haul them directly to the picker without stacking. This practice is an especially successful method of saving labor in Central Texas and where windrowing is done with a side delivery rake. Peanuts handled in this manner are subject to damage in a wet fall and will require turning if they become wet.

Cover Crops: Peanuts leave the land especially devoid of protective vegetation and litter. Planting a winter cover crop is a sound investment in protecting the land from undue depletion or erosion. A suitable winter legume crop, if turned under, will pay its costs through increased crop yields. Winter oats will pay as a pasture in addition to the benefit to be obtained from protecting the land.

SUMMARY

1. To help meet essential needs for oil, southern farmers are being asked to grow 5.5 million acres of peanuts in 1943. Louisiana's share of this goal is 75,000 acres.

2. At prices which prevailed in 1942, peanuts at $84 a ton were less profitable than cotton, and most other crops that were produced on farms in the hill sections of the State. However, most farmers who made 400 pounds or better of peanuts per acre added to their farm earnings provided it was not necessary for them to reduce the acreage of more profitable crops.

3. Judging from the experience of farmers in 1942, yields of at least 600 pounds of peanuts per acre can be obtained on suitable soils providing reasonably good practices are followed. This conclusion is also supported by Experiment Station results with the crop.

4. With a price of at least $120 a ton, peanuts yielding 600 pounds are more profitable than cotton yielding 200 pounds and bringing 18 to 19 cents a pound. The per acre returns from peanuts would be somewhat less than from cotton, but six acres of peanuts can be grown with the same amount of labor that is required for four acres of cotton. This is especially important in wartime when it is difficult to obtain labor.

5. In 1942, peanuts were planted, cultivated, and harvested largely during the same periods when cotton and other crops required attention. This competition for the use of labor limits the acreage of peanuts that may be grown without reducing the acreage of other crops. However, peanuts may be planted from about the first of April until the middle of June. By staggering plantings during this period the conflict in labor requirements may be minimized.
6. Most small farms have enough family labor and idle cropland to grow at least three acres of peanuts. Many have enough labor and land to grow seven or more acres of peanuts without reducing other crops, providing peanut planting dates are carefully staggered to avoid labor problems at harvest time. Other farms, faced with a short labor supply, may find it profitable to increase peanut acreage at the expense of other crops, particularly on land that produces cotton yields of less than 200 pounds. By substituting peanuts for cotton it may be possible to utilize available labor and land more efficiently.
7. To grow peanuts successfully and profitably it is necessary to handle the crop in the same business-like manner that other crops are grown. The practices of first importance in producing a good yield of peanuts are:
    (a) planting an ample amount of good seed in a well prepared seed bed, and
    (b) thorough cultivation with proper tools during the early stages of growth.
8. With prices supported at $120 or higher, and added "incentive" payments, peanuts will be relatively profitable in 1943. With favorable price-relationships farmers generally will find it to their advantage to increase their acreage of peanuts, even to the extent of shifting some labor and land from cotton to peanuts.

LOUISIANA BULLETIN NO. 362 APRIL, 1943

PROGRESS OF FREE CLASSING AND MARKET NEWS SERVICE FOR MEMBERS OF COTTON IMPROVEMENT GROUPS IN LOUISIANA

by

HERSCHEL W. LITTLE AND ROY A. BALLINGER

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PROGRESS OF FREE CLASSING AND MARKET NEWS SERVICE FOR MEMBERS OF COTTON IMPROVEMENT GROUPS IN LOUISIANA

by

HERSCHEL W. LITTLE AND ROY A. BALLINGER

INTRODUCTION

With the passage in 1937 of what is commonly known as the Smith-Doxey Act, the Federal government set up machinery designed to improve the bargaining power of growers of improved qualities of cotton in the sale of their product. Many producers are at a considerable disadvantage in bargaining with buyers for the sale of their cotton, because they lack specific knowledge of the grade and staple length of their cotton and the market price of particular qualities. Numerous studies made by the Federal government and by State experiment stations have shown that the relationship between price and quality in local markets is highly irregular. The farmer receives on the average only a small portion of the premiums that should be paid for superior grades and longer staple lengths as measured by premiums paid for these qualities in central markets.[1] It was largely to help correct this situation that the Smith-Doxey Act was passed.

The act provides for furnishing farmers, who belong to organized cotton improvement groups, a free official classification of their cotton, and market news information for use in connection with this classification in determining approximately what prices their particular qualities of cotton should bring. Groups of growers who have organized for the purpose of producing a single variety of cotton have been the principal type of cotton improvement group to take advantage of the program. The objective of a one variety group is to bring about the production of a large volume of cotton of uniformly superior quality, which can be sold for a premium. Since this objective is largely defeated if price premiums are not received for improved cotton, some reliable system of classification and market news is important to their success.

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[1] Howell, L. D., and Watson, Leonard, Jr., 1939, *Cotton Prices in Relation to Cotton Classification Services and to Quality Improvement,* U. S. Department of Agriculture Technical Bulletin 699.

Data on which this report is based were obtained mainly through interviews with officers and members of cotton improvement groups. The first section of the report deals largely with the groups themselves and the relationship of certain factors to their success. This part of the study is based upon data obtained from the Agricultural Marketing Administration of the United States Department of Agriculture and other information from the officers of 42 of the 46 groups which applied for the services of the Smith-Doxey program for the 1941-42 cotton marketing season.

The second section of this report consists of an analysis of the benefits received from the program by four selected groups whose members used the services. Detailed information was obtained from 125 members of these groups. There were 76 members interviewed who submitted samples for classification and 49 who did not. Comparative figures for the season 1939-40 are taken from a similar study of the Smith-Doxey program made during that season.[1]

A more equitable proportion for the statistical sample might have been obtained by interviewing a larger number of members who did not submit samples, since, for the state as a whole during the 1941-42 season, about 40 per cent of the cotton eligible for classification was submitted for classification, while 60 per cent was not. However, the major portion of the study deals with the actual use made of the service, and it is felt that the statistical sample is adequate from this point of view. Probably enough questionnaires were obtained from members in the areas where the study was made to determine accurately why they did not submit samples. It is not necessarily true that the findings in the areas studied can be applied to the state as a whole, although very similar conditions exist in other sections of the state. The selection of the areas to be studied was influenced considerably by the fact that the yield of cotton was very small in the north-central and western sections of the state in 1941.

DESCRIPTION OF THE PROGRAM

The Smith-Doxey cotton classification and market news program is available to cotton producers only on a group basis and not to individual producers, as such. Any group made up of producers who have organized for the improvement of their cotton is eligible to apply to the United States Department of Agriculture for free classification of the cotton belonging to its members and for market news information for use by members in the sale of their cotton.

The United States Department of Agriculture has set up classing offices at various points throughout the cotton belt to which samples are shipped for classification under the Smith-Doxey Act. In order to expedite the handling of samples in Louisiana, the Louisiana State Department of Agriculture and Immigration has cooperated with the United States Department of Agriculture in establishing an office at Alexandria. All Classing is done by expert federal classers, and an official card showing the grade and staple length for each individual bale is returned to the grower. Usually, two or three days are required for samples to reach the classing office and for the class to be returned to the grower, provided the samples are shipped promptly by the person or agency doing the sampling at the gin. In addition, information regarding market price quotations is sent daily to representatives of the group who are to keep the information posted. In general, these quotations show the premiums and discounts above and below New York and New Orleans future prices for all grades and staple lengths. This information, together with the government classification of his cotton and information regarding the normal spread in price between central and local markets, makes it possible for a farmer to determine approximately what his particular bales of cotton should be worth in the local market at any time.

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[1] Ballinger, Roy A., and Little, Herschel W., "The Use of Free Classing and Market News Service by Members of Cotton Improvement Groups in Louisiana," Mimeographed Circular No. 14, Department of Agricultural Economics, Louisiana Agricultural Experiment Station.

In order to obtain the service, the local group must take the samples, properly identify and ship them to a government classing office, and keep the market news information posted in the local market. Samples of cotton to be classed under the program are usually taken by local ginners or warehousemen at the time of ginning or upon delivery to the warehouse. The United States Department of Agriculture furnishes each sampling agency with bags in which to ship the samples and pays the shipping charges. The service is, therefore, entirely free to members of the groups.

It is required that each sample submitted consist of two parts, one part taken from each side of the bale, and that each part weigh at least 3 ounces. Each sample must be properly identified by tags showing the number of the bale which the sample represents and the owner's name and address. Samples may be either cut from two sides of the bale or taken from the gin press box at the beginning and end of the ginning process. Careful instructions are given the person who is to do the sampling as to the proper method of taking the sample by a representative of the United States Department of Agriculture. In cases where samples are to be taken from the press box, a sample rolling device is usually used as an aid in obtaining a better sample.

PROGRESS IN LOUISIANA AND OTHER MISSISSIPPI VALLEY STATES

During the three years that the program has been in full operation, the acreage of cotton in Louisiana eligible to be classed under the Smith-Doxey Act increased about seven times, from 36,632 to 261,885 acres (Table 1). Increases in some of the other Mississippi Valley States have been as phenomenal. In Louisiana, in 1939, the acreage eligible for free classification was slightly more than three per cent of the total acreage in cotton in the state. By 1941, this figure had increased to over one-fourth of the total acreage. The only other state in the Mississippi Valley in which the proportion of the acreage eligible for classification was greater in 1941 was Missouri, where almost 45 per cent of the state's total acreage was included in groups which made application for the Smith-Doxey service.

TABLE 1. PER CENT OF STATE COTTON ACREAGE INCLUDED IN SMITH-DOXEY COTTON IMPROVEMENT GROUPS, MISSISSIPPI VALLEY STATES, 1939 TO 1941

STATE	TOTAL ACREAGE OF SMITH-DOXEY GROUPS			PER CENT OF STATE ACREAGE INCLUDED IN SMITH-DOXEY GROUPS		
	1939	1940	1941	1939	1940	1941
Louisiana	36,632	120,679	261,885	3.2	10.7	25.4
Arkansas	92,547	125,891	279,368	4.4	6.1	13.8
Mississippi	131,980	229,772	322,701	5.2	9.2	13.6
Missouri	14,689	49,943	185,045	3.9	12.2	44.9
Tennessee	5,146	9,267	136,758	.7	1.3	19.5

At first, even those groups which applied for the service were rather slow to take advantage of the free classification. This was especially true in Louisiana. In 1939, only 900 samples were submitted for classification from the whole state (Table 2). As members became more aware of the advantages of the program, a larger number began to avail themselves of the service. In 1940, over 25 thousand, and in 1941, over 30 thousand samples were classed for cotton improvement groups in Louisiana. In Arkansas, from 1939 to 1941, the volume of cotton classed under the act increased from a little less than 13 thousand to almost 112 thousand samples. Volume increased in Mississippi during this same period from 16 thousand to over 60 thousand; in Missouri, from 3.5 thousand to over 70 thousand; and in Tennessee, from one thousand to over 19 thousand.

TABLE 2. PER CENT OF COTTON PRODUCTION CLASSED UNDER SMITH-DOXEY ACT, MISSISSIPPI VALLEY STATES, 1939-41

STATE	NUMBER OF SAMPLES CLASSED			PER CENT OF PRODUCTION CLASSED		
	1939	1940	1941	1939	1940	1941
Louisiana	900	25,568	30,203	.1	5.7	9.7
Arkansas	12,643	47,144	111,854	.9	3.2	8.1
Mississippi	16,300	47,273	62,607	1.1	3.8	4.5
Missouri	3,479	22,095	69,365	.8	5.5	14.7
Tennessee	964	2,047	19,102	.2	.4	3.3

From the standpoint of volume alone, it would appear that groups in Louisiana have not taken advantage of the free classing to the same extent as those in some of the other states. However, Louisiana had exceedingly short crops in both 1940 and 1941, and, for that reason, the

TABLE 3. ESTIMATED NUMBER OF BALES PRODUCED BY SMITH-DOXEY COTTON IMPROVEMENT GROUPS, NUMBER OF BALES AND PER CENT OF ELIGIBLE COTTON SUBMITTED FOR CLASSIFICATION 1939-40 TO 1941-42

STATE	1939-40			1940-41			1941-42		
	Estimated* number of bales produced by Smith-Doxey groups	Number of samples submitted for classification	Per cent of eligible cotton submitted for classification	Estimated* number of bales produced by Smith-Doxey groups	Number of samples submitted for classification	Per cent of eligible cotton submitted for classification	Estimated* number of bales produced by Smith-Doxey groups	Number of samples submitted for classification	Per cent of eligible cotton submitted for classification
Louisiana	23,271	900	3.85	46,823	25,568	54.61	76,994	30,582	39.22
Arkansas	59,045	12,643	21.41	87,872	47,144	53.65	191,646	111,854	58.37
Mississippi	78,924	16,300	20.65	110,291	47,273	42.86	185,230	62,607	33.80
Misssouri	16,305	3,479	21.34	55,337	22,095	39.93	210,591	69,365	32.94
Tennessee	3,139	964	30.71	6,300	2,047	32.49	112,415	19,102	16.99
TOTAL	180,684	34,286	18.98	306,623	154,127	50.27	776,876	293,510	37.78

*Figure arrived at by multiplying the Bureau of Census figure for average yield per acre in each state by total acres planted by cotton improvement groups. It should be noted that the estimated production of groups in Louisiana for the 1941-42 season is somewhat lower than estimated production in Table 6, which is based on estimates of officials interviewed in each individual group. The method used in this table makes it possible to compare the data for different states and different years.

number of samples submitted was considerably smaller than probably would have been the case under normal conditions. A more accurate measure of the extent to which the program has been reaching cotton producers may be gained by considering the relation between the number of samples classed and the total production of cotton in the various states. In 1939, only one-tenth of one per cent of the total crop in Louisiana was classed under the Smith-Doxey program. The proportion increased to almost six per cent in 1940 and 10 per cent in 1941. The only other state under consideration which exceeded this figure was Missouri, with approximately 15 per cent. Approximately 8 per cent of the cotton produced in Arkansas, 5 per cent in Mississippi, and 3 per cent in Tennessee was submitted for classification during 1941 by organized cotton improvement groups.

In Missouri and Louisiana, where the proportion of the state's production classed was highest, the proportion of the state's acreage included in Smith-Doxey groups was also highest. Almost 45 per cent of the acreage planted to cotton in Missouri and about 50 per cent in Louisiana was included in Smith-Doxey groups. Of the cotton produced which was eligible to be classed, a larger proportion was submitted for classification from Arkansas than from any of the other states (Table 3). It is estimated that approximately 58 per cent of the cotton produced by Smith-Doxey groups in Arkansas, 39 per cent in Louisiana, 33 per cent in Mississippi and Missouri, and 17 per cent in Tennessee was submitted for free classification.

It should be noted that, in some of the states under discussion, a relatively large proportion of the samples was submitted in connection with demonstration programs carried on by the Surplus Marketing Administration of the United States Department of Agriculture. These programs were operated in different areas of the cotton belt to demonstrate the feasibility of a planned marketing program on the part of cotton improvement groups. In the demonstration groups, all cotton in the program was sold strictly on government grade, usually through a broker selected by the group. Samples were taken before the bale was wrapped, and bales were usually wrapped in cotton bagging. The ginner as well as the broker was paid a fee for his part in the program. This is in direct contrast to the regular Smith-Doxey groups, where the ginners received no compensation for their services in taking and mailing the samples, and the government classification and market news information was used only as a tool for bargaining with local buyers.

In a sense, the number of samples submitted by groups which were not a part of the demonstration program is a better measure of the extent to which the Smith-Doxey program itself was used, since participation was based entirely upon the benefits to be received through possession of classing and market news information. Those who participated in the demonstration program expected to receive certain benefits in addition to those from the Smith-Doxey service. If the samples submitted by the demonstration group, located near Shreveport, which has operated in Louisiana the last two years are excluded, the trend in number of samples classed for regular cotton improvement groups was very decidedly upward (Table 4). From 900 samples in 1939, the number increased to over 13 thousand in 1940 and to over 24 thousand in 1941. This trend is partially obscured when samples submitted under the demonstration program are included, because only about half as many samples were classed for the demonstration group in 1941 as in 1940. This was caused by the extremely short crop in the demonstration area in 1941.

TABLE 4. NUMBER OF SAMPLES SUBMITTED BY REGULAR COTTON IMPROVEMENT GROUPS AND BY SURPLUS MARKETING ADMINISTRATION DEMONSTRATION GROUPS, LOUISIANA 1939-41.

SEASON	NUMBER OF SAMPLES SUBMITTED			PER CENT OF SAMPLES SUBMITTED		
	By regular cotton improvement groups	Under S. M. A. demonstration program	TOTAL	By regular cotton improvement groups	Under S. M. A. demonstration program	TOTAL
1939-40...	900	0	900	100	0	100
1940-41...	13,321	12,247	25,568	52	48	100
1941-42...	24,126	6,077	30,203	80	20	100

Approximately 60 per cent, or almost 38 thousand samples classed in Mississippi during 1941 were for groups participating in demonstration programs. This was true of about 38 per cent of the cotton classed in Missouri. On the other hand, only 16 per cent of the volume classed for Arkansas and 20 per cent of that for Louisiana was for demonstration groups. Mississippi had a larger number of demonstration groups than any of the other states under consideration (Table 5).

TABLE 5. NUMBER AND PER CENT OF SAMPLES SUBMITTED BY REGULAR COTTON IMPROVEMENT GROUPS AND SURPLUS MARKETING ADMINISTRATION DEMONSTRATION GROUPS, MISSISSIPPI VALLEY STATES, 1941.

STATE	NUMBER OF SAMPLES SUBMITTED			PER CENT OF SAMPLES SUBMITTED		
	By regular cotton improvement groups	Under S. M. A. demonstration program	TOTAL	By regular cotton improvement groups	Under S. M. A. demonstration program	TOTAL
Louisiana..	24,126	6,077	30,203	80	20	100
Arkansas..	94,095	17,759	111,854	84	16	100
Mississippi	25,004	37,603	62,607	40	60	100
Missouri..	42,975	26,390	69,365	62	38	100
Tennessee.	14,389	4,713	19,102	75	25	100

COTTON IMPROVEMENT GROUPS IN LOUISIANA

In Louisiana, the majority of improvement groups are concentrated in the northern half of the state where cotton production is heaviest. During the 1941-42 season, however, five groups in south Louisiana made application for free classification and market news for the first time, and there are indications of a further increase in interest in that part of the state. For the state as a whole, the number of groups applying for the Smith-Doxey service has remained about the same since the beginning of the program, but the scope of many of the groups has expanded considerably. In 1939, all but two of the 31 groups were limited to a single community. In 1940 and 1941, many of the groups formerly organized on a community basis were changed so as to cover all or a major portion of a parish, and, in addition, a number of new groups organized on such a scale made application for the service. During 1940, 10 of the 48 groups which applied for the service covered all or a considerable portion of the parish in which they were located. This was true of 18 of 46 Smith-Doxey groups in 1941. The fact that the total acreage included in Smith-Doxey groups increased from 3 per cent of the state's total acreage in 1939 to over 25 per cent in 1941 is an indication of the extent to which the groups have been enlarged.

Distribution of Membership, Acreage, and Production

The United States Department of Agriculture has divided Louisiana into four reporting districts, in order to show variations in the grade and staple length of cotton in their quality statistics reports. Comparison of the organized groups located within these districts indicates that there was a considerable amount of variation between districts in 1941-42 in the membership, acreage, and production of the Smith-Doxey groups and also in the extent to which their members took advantage of the opportunity to have their cotton classed. The section of Louisiana known as District Number 1 includes most of the Red River Delta and that part

TABLE 6. NUMBER AND PER CENT OF COTTON IMPROVEMENT GROUPS MEMBERSHIP, ACREAGE, AND PRODUCTION IN LOUISIANA BY GRADE AND STAPLE DISTRICTS, 1941-42 SEASON.

DISTRICT	NUMBER				PER CENT		
	Groups	Members	Acres in cotton	Estimated* bales produced	Members	Acres in cotton	Estimated* bales produced
1.	13	4,940	127,817	40,967	47	49	48
2.	13	2,567	49,275	9,221	24	19	11
3.	14	2,442	74,213	30,832	23	28	36
4.	6	587	10,521	4,629	6	4	5
TOTAL. . . .	46	10,536	261,829	85,649	100	100	100

*Based on estimates of production obtained from officials of individual groups.

of the state west of the Red River. District Number 2 comprises most of the hill section of central Louisiana; District Number 3, the Mississippi Delta section; and District Number 4, south Louisiana.

Over ten thousand members belonged to the 46 cotton improvement groups which applied for the Smith-Doxey service in 1941, almost five thousand of whom were located in District No. 1 (Table 6). Approximately 2,500 each were located in Districts No. 2 and 3, and about 500 in south Louisiana. About 128,000 acres of cotton, or almost 50 per cent of the total acreage planted by Smith-Doxey groups, and 48 per cent of the total estimated production was in District No. 1. The crop was unusually small in 1941 in all districts except the upper part of District No. 3. Approximately 36 per cent of the estimated production of cotton by Smith-Doxey cotton improvement groups was in District No. 3, where only 28 per cent of the total acreage was located.

Groups located in District No. 1 had a larger average membership, acreage, and production than groups located in other parts of the state (Table 7). Those in District No. 2 were, on the average, next largest from the point of view of membership, but those in District No. 3 had larger acreages than occurred in other parts of the state, except in District No. 1. District No. 1 had an average production of slightly over 3,000 bales per group which were produced by 380 members on a little less than 10,000 acres. Individual groups ranged from as low as 8 to as high as 1,100 members.

TABLE 7. AVERAGE NUMBER OF MEMBERS OF COTTON IMPROVEMENT GROUPS AND AVERAGE ACREAGE AND PRODUCTINN PER GROUP AND PER MEMBER BY GRADE AND STAPLE DISTRICTS IN LOUISIANA, 1941-42 SEASON.

DISTRICT	Average number of members per group	AVERAGE ACREAGE		AVERAGE BALES PRODUCED	
		Per group	Per member	Per group	Per member
1....................	380	9,832	26	3,151	8
2....................	197	3,790	19	709	4
3....................	174	5,301	30	2,202	13
4....................	98	1,754	18	772	8
TOTAL........	229	5,692	25	1,862	8

The cotton improvement groups in District No. 4 averaged the smallest of any in the state in acreage but not in production. The average acreage planted to cotton by members was greatest in Districts 3 and 1, both of which are largely delta areas. The number of bales produced per member was highest in District No. 3, where the yield was best in Louisiana in 1941. In District No. 1, the average number of bales produced per member was much smaller than would have been the case under more favorable crop conditions. This is also true in Districts 2 and 4, but the size of crop produced is also naturally smaller in these districts than in the Red River and Mississippi River deltas.

Distribution of Samples Submitted

Those groups located in Districts No. 3 and 4, in the Mississippi Delta and south Louisiana, took advantage of the opportunity to have their cotton classed during 1941 to a greater extent than did those in the Red River Delta and hill sections of the state (Table 8). Approximately 48 per cent of the estimated production of groups in the Mississippi Delta and 56 per cent of the production by those in south Louisiana was submitted for classification under the Smith-Doxey Act, as compared with only 29 and 19 per cent submitted by groups in the Red River Delta and hill sections of the state. It should also be noted that 6,418 of the 11,954 samples submitted from the Red River Delta came from the demonstration group sponsored by the Surplus Marketing Administration which was located in the area, so that less than half of the 29 per cent of eligible cotton submitted from this district came from regular Smith-Doxey groups.

TABLE 8. NUMBER OF BALES PRODUCED, NUMBER OF SAMPLES SUBMITTED, AND PER CENT OF ELIGIBLE COTTON SUBMITTED FOR CLASSIFICATION, BY GRADE AND STAPLE DISTRICTS, 1941-42.

DISTRICT	Number of bales produced	Number of samples submitted	Per cent of eligible cotton sampled
1	40,967	11,954*	29
2	9,221	1,738	19
3	30,832	14,144	46
4	4,629	2,748	59
TOTAL	85,649†	30,582	36†

*Includes 6,418 samples submitted by Surplus Marketing Administration demonstration group at Gilliam.

†Based on estimates of officials interviewed in each individual group. These figures are somewhat higher than the estimated production shown in Table 3, which were calculated from census data of yields per acre.

Varieties and Qualities Produced

In making the free classification and market news program available to organized cotton improvement groups, a group has been considered eligible to participate in the program if it has been organized for the purpose of growing a single variety of cotton. The majority of the groups in Louisiana which have applied for the Smith-Doxey service have grown the Deltapine variety (Table 9). Nearly 94 per cent of the groups grew this variety in 1939, 98 per cent in 1940, and 87 per cent in 1941. Stoneville and Delfos were the only other varieties grown.

TABLE 9. VARIETIES USED BY ORGANIZED COTTON IMPROVEMENT GROUPS IN LOUISIANA, 1939-40 TO 1941-42.

VARIETY	NUMBER OF GROUPS		
	1939-40	1940-41	1941-42
Deltapine	29	47	40
Stoneville	0	1	6
Delfos	2	0	0
TOTAL	31	48	46

Since the primary purpose of cotton improvement groups is to improve the quality of cotton produced, a comparison of the grade and staple length of the cotton classed by the Government for the members of such groups and the average quality produced in Louisiana gives some indication of the success of the groups (Table 10). Most of the differences in grade do not appear to be very significant, although, in general, the cotton classed for organized groups averaged somewhat lower in grade than the state averages. This is particularly true in District 4, which covers all of south Louisiana. Differences in staple length were more favorable to the quality improvement groups. These groups had a much larger proportion of cotton 1 1/32 inches in length than did the state as a whole and a somewhat larger proportion of 1 1/16 inch cotton. Quality improvement groups had a smaller proportion of both the shorter and the very long staple lengths than was true of the rest of the state.

Agencies Cooperating in Sampling

One of the most serious problems involved in the carrying out of the program has been that of finding a workable system of taking samples at the gins. A considerable amount of work is involved in taking and shipping samples to the government classing office. Since the person performing this function usually receives no compensation for his services, the group often has difficulty in finding someone to perform the work. The job is usually delegated to local ginners or warehousemen. Often the degree of cooperation depends upon the public spiritedness of the individual or agency concerned, or upon the extent to which they are forced to cooperate because of the fear of losing customers.

A total of 157 agencies cooperated with organized groups in Louisiana in taking samples during the 1941-42 season. Of these agencies, 155 were gins, and 2 were warehouses. The gins which cooperated ginned a total of 85,000 bales of cotton. In District No. 1, they ginned 26,002 bales. Since an estimated 40,967 bales were produced by organized groups in this area, it is evident that the number of sampling agencies would not have been sufficient to care for the production if growers had attempted to submit all eligible cotton for classification. In other sections of the

TABLE 10. PERCENTAGE DISTRIBUTION BY GRADE AND STAPLE LENGTH OF SAMPLES OF COTTON SUBMITTED FOR CLASSIFICATION BY IMPROVEMENT GROUPS AND BY GINS REPORTING FOR QUALITY STATISTICS, LOUISIANA, 1941-42.

GRADE AND STAPLE LENGTH	IMPROVEMENT GROUPS					QUALITY STATISTICS GINS				
	DISTRICT				State	DISTRICT				State
	1	2	3	4		1	2	3	4	
	(Grade)									
White										
G. M.	*	....	*	....	*	....	....	.3	.2	.2
S. M.	2.8	5.3	2 2	.1	2.4	3.5	1.3	5.4	5.3	4.8
M.	20.8	17.8	22.8	8.2	20.4	16.0	13.2	26.7	20.6	22.5
S. L. M.	32.5	42.8	55.2	61.4	46.1	34.6	40.2	40.2	50.1	42.7
L. M.	5.5	3.1	3.8	18.4	5.8	5.6	1.9	8.5	13.6	9.3
S. G. O.	.3	....	.2	1.1	.3	.9	.1	.6	1.0	.7
G. O.	.1	....	*	.1	*	.1	....	*	.2	.1
Spotted										
G. M.	.1	.1	.1	*	.1	.1	*	.1	....	.1
S. M.	12.9	19.2	11.2	2.2	11.5	16.1	26.2	13.5	4.0	11.9
M.	22.0	11.6	4.3	6.9	11.9	20.7	16.6	4.1	4.3	7.0
S. L. M.	2.7	.1	.1	1.4	1.3	2.3	.4	.4	.3	.5
L. M.	.2	....	....	*	.1	.1	....	*	....	*
Other	....	....	....	....	....	....	....	.1	.4	.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	(Staple length)									
Shorter than $^{7}/_{8}$	....	....	....	....	....	.1	.1	....	*	*
$^{7}/_{8}$	.1	1.3	....	....	.1	.3	6.6	.1	*	.6
$^{29}/_{32}$	*	1.3	*	....	.1	.5	5.4	.2	.1	.7
$^{15}/_{16}$	.3	7.0	*	.1	.5	2.7	16.3	.4	1.1	2.2
$^{31}/_{32}$	1.6	17.7	.4	.6	1.9	8.2	32.0	2.3	3.5	5.8
1	14.0	46.8	11.9	14.4	14.9	28.5	31.3	17.3	20.4	20.6
1$^{1}/_{32}$	52.5	22.4	37.7	37.1	42.5	41.2	7.4	30.7	28.8	29.3
1$^{1}/_{16}$	29.7	3.5	47.1	46.6	37.8	16.9	.9	38.9	40.7	33.9
1$^{3}/_{32}$	1.7	....	2.6	1.1	2.0	1.5	....	7.0	5.2	5.3
1$^{1}/_{8}$	.1	....	.3	.1	.2	.1	....	3.1	.1	1.5
Other	....	....	*	....	*	....	....	....	.1	*
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
AVERAGE STAPLE LENGTH	33.1	31.9	33.4	33.3	33.2	32.6	31.0	33.4	33.2	33.1

*Less than .05 per cent.

state, it appears that the number of gins cooperating was adequate to care for the volume of cotton produced by organized groups (Table 11). Unfortunately, reliable figures regarding the proportion of ginnings of cooperating gins actually eligible for classification are not available, since a portion of the cotton produced by organized groups may have been ginned at gins which did not cooperate.

TABLE 11. ESTIMATED NUMBER OF BALES GINNED BY GINS WHICH COOPERATED IN TAKING SAMPLES AND PER CENT OF GINNINGS SAMPLED, 1941-42 SEASON.

DISTRICT	Number of cooperating gins	Estimated bales produced by organized groups	Estimated number of bales ginned by cooperating gins	Per cent of ginnings sampled
1.	67	40,967	26,002	46
2.	27	9,221	10,789	16
3.	40*	23,031	40,533	34
4.	21	4,629	7,758	35
TOTAL	155	77,848	85,082	36

*Two groups for which sampling was performed by warehouses are excluded.

MARKETING CONDITIONS AND PRACTICES

Information regarding marketing conditions and practices in the local markets where members of cotton improvement groups sell their cotton may contribute to a better understanding of the necessity for and the usefulness of the free government classification and market news service. Under certain circumstances the problems involved in carrying out the program have been more difficult than under others. Often it has been in areas where the program is most needed that the problems have been most difficult.

Place of Sale and Place of Delivery

A large majority of the members of cotton improvement groups, during the three seasons from 1939-40 to 1941-42, sold their cotton at local gins or at buyers' offices. In a few markets, members usually sold at a warehouse and, in other cases, on the street. Of the 42 groups for which records were obtained for 1941-42, a gin was the most usual place of sale for 20 and the buyer's office for 20. Only three groups sold cotton at the warehouse and three on the street. In a few cases, two or more places were about equally important as places of sale (Table 12).

TABLE 12. USUAL PLACE OF SALE BY MEMBERS OF COTTON IMPROVEMENT GROUPS, 1939-40 TO 1941-42.

PLACE OF SALE	NUMBER OF GROUPS		
	1939	1940	1941
Gin	18	19	20
Buyer's office	5	11	20
Warehouse	2	3	3
Street	6	8	3
Other	6	4	3
TOTAL	31	38*	42*

*Several communities had more than one.

In cases where the growers sold at the buyer's office, sales were usually based on samples and warehouse receipts representing cotton already in warehouses. It is a general practice in parts of the state for cotton to be delivered to warehouses by the ginner the same day the cotton is ginned. Samples and warehouse receipts representing cotton in storage are returned to the grower through the ginner. In such cases, delivery is made by the grower's simply turning over samples and warehouse receipts to the buyer. The grower may take his samples to three or four different buyers to obtain bids before making a sale. Growers in 25 of the 42 groups under discussion usually made delivery to the buyer through the local compress or warehouse, and used warehouse receipts. Growers in 21 groups most frequently made delivery to the buyer at the gin. In one group, delivery was usually made at a country store and in another at the railroad platform (Table 13).

TABLE 13. USUAL PLACE OF DELIVERY BY MEMBERS OF COTTON IMPROVEMENT GROUPS, 1941-42.

PLACE OF DELIVERY	Number of growers
Gin	21
Compress or warehouse	25
Railroad platform	1
Store	1
TOTAL	42*

*Several communities had more than one common place of delivery.

In areas where sales were made to buyers at gins, it was sometimes the practice to sell cotton immediately after ginning. In such cases, there was not much incentive to have samples sent to the government classing office, because, by the time the class was returned, about three days later, the cotton was already sold. However, cotton sold at the gin was not necessarily sold immediately after ginning. Some of the most successful groups in the state during 1941-42 were located in areas where buyers came to the gin to buy most of the cotton. However, in areas where ginners themselves bought most of the cotton, the Smith-Doxey service has not usually been successful.

Relationship of Ginner Buying to Use of the Free Classing Service

Circumstances in markets where cotton ginners customarily buy a large part of the cotton they gin usually are unfavorable to the successful operation of the free classing and market news services. In such markets, growers often sold their cotton before the government class could be returned to them. Most important, however, is the fact that ginner buyers often were strongly opposed to the program. The ginners were usually asked to be responsible for the sampling of cotton for the classing service. Since they received no remuneration for this work, and since they frequently were asked to buy on the basis of the government class, there was considerable incentive for them to discourage members from submitting samples.

In Louisiana, during the 1941-42 season, those groups which sold in markets made up almost exclusively of ginner buyers submitted only 10 per cent of their estimated production for classification (Table 14).

TABLE 14. Per Cent of Eligible Cotton Production Submitted for Free Classification by Various Types of Cotton Improvement Groups, in Different Types of Markets, 1941-42.

Type of group	Market made up almost exclusively of ginner buyers	Partly ginner buyers in in market	Few or no ginner buyers in market	Total
	(Per cent of eligible production classed)			
Groups limited to one community.....	26	36	76	64
Groups covering several contiguous communities......................	1	9	32	26
Total.................	10	16	43	36

Groups selling in markets having partly ginner buyers submitted samples from 16 per cent of the cotton eligible for classification, while groups with few or no ginner buyers in the market submited over 40 per cent of their eligible cotton. For those groups whose membership was confined to a single community, it was found that over ¾ of the production was submitted for free classification, where ginners did not buy cotton, as com-

TABLE 15. Number of Groups and Samples Submitted by Various Types of Cotton Improvement Groups in Different Types of Markets, 1941-42.

Type of group	Market made up almost exclusively of ginner buyers		Partly ginner buyers in market		Few or no ginner buyers in market		Total	
	No .of groups	No. of samples	No. of groups	No. of samples	No. of groups	No. of samples	No. of groups	No. of samples
Groups limited to one community............	4	442	5	1,564	19	12,047	28	14,053
Groups covering all or portions of parish.......	2	24	5	1,208	11	15,297	18	16,529
Total...........	6	466	10	2,772	30	27,344	46	30,582

pared with only $\frac{1}{4}$ where ginner buying was common. Only one per cent of the eligible cotton was submitted for classification from groups whose members covered several communities and where the markets were dominated by ginner buyers. In contrast, 32 per cent of the eligible cotton was submitted for free classification in markets where there were few or no ginner buyers.

The members of very few of the groups which applied for free classification and market news service sold their cotton in markets made up almost entirely or partly of ginner buyers (Table 15). Of the 28 groups in the state which were organized on a single community basis during the 1941-42 season, 19 sold in markets with few or no ginner buyers and submitted over 85 per cent of the samples received from such groups. Of the 18 groups covering several communities, 11 sold in markets having few or no ginner buyers, and submitted over 90 per cent of the samples received from such groups.

Members' Knowledge of Marketing Conditions

Accurate knowledge of the grade and staple length of their cotton is only a part of the information needed by growers if they are to bargain effectively with buyers on the basis of quality in the sale of their cotton. If a grower has a bale of strict middling, 1 1/32 inch cotton, he should have information at hand that will enable him to calculate approximately what strict middling 1 1/32 inch cotton is worth in his local market at the particular time he sells. Without such knowledge it is a relatively easy matter for the local buyers to agree with the grower and the government that the cotton is strict middling 1 1/32, or even better, and yet pay him a price properly applicable to a poorer quality of cotton. This appears to have happened fairly frequently in some areas in the past.

The United States Department of Agriculture sends daily, during the cotton marketing season, reports, showing premiums and discounts above and below New York and New Orleans futures for all grades and staple lengths in various central markets, to one or more representatives of each of the cotton improvement groups. These reports are supposed to be posted at central locations in the local markets for use by members at the time they sell their cotton.

Obviously, one disadvantage to the grower in using quotations which have come through the mail is that they represent prices existing from one to three days earlier. However, this disadvantage is not as great as might at first appear. Price differentials for grade and staple length ordinarily change very little from day to day, although the basis price to which these differentials are applied may vary greatly within a short period of time. Arrangements have been made with radio stations in all parts of the cotton belt to broadcast the price of New York and New Orleans futures at definite intervals each day. Members of groups are notified regarding the hours of these broadcasts by stations serving their particular area. Price differentials shown on government quotation sheets when applied to the price of New York or New Orleans futures as determined from the radio or other local sources just prior to sale, enable the grower to determine within a relatively close range what cotton of his particular qualities is selling for in central markets. To determine how much his cotton is worth locally, it is then necessary to subtract from the central market price an amount equal to the approximate cost of freight and handling charges from the local to the central market. However, a correct approximation of the price may not always be arrived at in this manner, since in some cases cotton may not go through the central markets for which quotations are furnished but may be shipped directly to mills. Other circumstances surrounding particular sales in local markets may also cause the price to be out of line with what would be expected through subtracting freight and handling charges from central market quotations.

It is apparent from this that the determination of the spread between the local and central market is a rather difficult problem, especially since the leader of the group, whose responsibility it is to look into the matter, has usually had no experience along this line and neither have other persons in the community who would be willing to help solve the problem. Numerous items enter into the cost of assembling and handling cotton and moving it to central markets. The costs also vary from time to time. Shippers have learned from experience what margin they need for performing these various services and are not anxious to give this information to growers.

Of the 42 groups investigated during the 1941-42 season, the quotations from the government were not posted except, perhaps, at infrequent intervals for 19 groups. Quotations were posted most of the time for 23 of the groups, but indications were that only 14 made good use of them. Three of the groups posting the quotations made some use of them, while 6 groups did not use them at all (Table 16). The gin was the most usual place for posting price quotations and the general store the next most important. A few groups used the post office or county agent's office (Table 17).

TABLE 16. EXTENT TO WHICH MARKET NEWS INFORMATION WAS USED 1941-42 SEASON.

No. of groups making *good* use of quotations	14	
No. of groups making *some* use of quotations	3	
No. of groups making *no* use of quotations	6	
Total No. of groups posting quotations		23
No. of groups failing to post quotations		19
TOTAL NUMBER OF GROUPS INTERVIEWED		42

It seems that one of the most difficult problems yet to be solved with respect to the free classing-market news program is that of effectively tying up price with quality in the minds of the growers at the time they sell their cotton. Probably, the main reason why government quotations were not used to a greater extent than they were is that growers did not know how to interpret them in terms of local market prices. The solution to the problem will probably have to come through more assistance and education by interested agencies which are in a position to explain the quotation sheets and the determination of spreads bewteen local and central market prices. Perhaps, the quotation sheets themselves could also be simplified somewhat.

TABLE 17. PLACE OF POSTING MARKET NEWS INFORMATION 1939-40 AND 1941-42 SEASON.

PLACE	NUMBER OF GROUPS	
	1939	1941
Gin	12	14
General store	5	6
Post office	1	2
County agent's office	0	2
Other	4	3
Not posted	9	19
TOTAL	31	46*

*Some groups posted information in more than one place.

Attitudes of Local Buyers

A considerable proportion of the cotton buyers appear to be rather strongly opposed to government classing and market news, but, during the last two seasons, the number who are favorable seems to have increased. For the 1941-42 season, buyers operating in the markets used by 14 of the 42 groups under consideration were unfavorable in their attitude toward the service, buyers in 10 seemed indifferent, while in 15 they were favorable. For the 1939-40 season, buyers operating in markets used by only 2 out of 31 groups seemed favorable in their attitude toward

TABLE 18. GENERAL ATTITUDES OF BUYERS TOWARD GOVERNMENT CLASSING AND MARKET NEWS, 1939-40 TO 1941-42*

ATTITUDE	NUMBER OF GROUPS		
	1939-40	1940-41	1941-42
Favorable	2	14	15
Unfavorable	21	23	14
Indifferent	8	0	10
Attitudes mixed	0	0	3
TOTAL	31	37†	42

*This classification is necessarily rather arbitrary, because attitudes cannot be measured accurately.
†Information concerning buyers' attitude was not available from one community.

the service (Table 18). Many local buyers have come to realize that the government is not attempting to injure the business of cotton buyers and that the government's class actually is not out of line with the buyers' estimate of quality. The government loan program has also been a factor in encouraging buyers to give more consideration to grade and staple length during times when prices are about on a level with loan values, since loan values vary according to quality.

However, many buyers are still very critical of the program. The criticism has usually taken the form of claiming that the government is overclassing or underclassing the cotton. A study of local cotton markets in Louisiana in 1940[1], however, indicates that many local buyers are in a poor position to pass judgment as to the accuracy of government classing, since their own classing is probably not very accurate. Classers must constantly check their classing against grade standards and staple types if their judgment is to remain accurate. However, most of the buyers in 1940 neither owned nor had access to official government standards. It might, perhaps, be argued that, in the case of buyers who purchase for a particular firm, the company would tend to keep their classing accurate, purely as a business proposition. It is true that such firms probably will immediately notify their local representatives whenever they are placing too high a class on the cotton purchased, but they might not do so if the classing was too low and the buyer was still obtaining the expected volume of cotton. It is probable that independent buyers, when competition permtis, buy cotton at a sufficiently wide margin below the price for which they expect to resell it to cover any losses which they might incur through inaccurate classing. Government classing is done with constant reference to all official grade standards and staple types, under relatively good conditions with respect to light, and always by classers having considerable experience in the cotton trade and government service. Consequently, it seems probable that, in cases of doubt, the government's classification is much more likely to be correct than that of many local buyers.

FACTORS RELATED TO THE USEFULNESS OF FREE CLASSIFICATION AND MARKET NEWS TO MEMBERS OF COTTON IMPROVEMENT GROUPS

A more intensive investigation of benefits received by members of cotton improvement groups from the free classing and market news service, their attitudes toward the program, and factors affecting its usefulness was made in four parishes in the state for the crop year 1941-42. In Catahoula Parish, the program had been available to growers since 1939, and in West Carroll Parish, since 1940. In most of Morehouse and all of Pointe Coupee Parishes, the program was in operation for the first time in 1941-42. The three groups in Catahoula Parish and the six groups in Morehouse Parish were organized on a community basis. Each community was organized as a separate group. In West Carroll Parish, there were originally 14 separate one-variety groups organized on a community basis, but in 1940, all the community groups consolidated into one parish-wide group. Pointe Coupee Parish had two cotton improvement groups, one included all communities in the northern and the other all communities in the southern part of the parish.

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[1] Little, H. W., and Ballinger, Roy A., "Cotton Marketing Practices in Selected Local Markets in Louisiana," Louisiana Agricultural Experiment Station Bulletin 345.

Members interviewed in Morehouse Parish produced considerably more cotton than those in the other parishes studied. The yield was better in Morehouse Parish than in Catahoula and Pointe Coupee, and the average member was also a larger producer. In Morehouse Parish, many of the members were plantation owners. In West Carroll and Catahoula Parishes, most of the members were smaller operators. In Pointe Coupee Parish, many of the members were plantation operators, but sugar cane and truck, rather than cotton, were often the main crops.

The average production per member was 138 bales in Morehouse Parish, 38 in Pointe Coupee, 27 in West Carroll, and 10 in Catahoula (Table 19). For the four groups as a whole the members who took advantage of the program by having their cotton classed had a considerably larger average production than did those who did not have their cotton classed. The average production per member was 71 and 43 bales, respectively.

Members' Ability to Class Cotton

Very few cotton growers have, from their own knowledge, more than a general idea as to what is the grade and staple length of their cotton. To become proficient in classing would nearly always require more of a farmer's time than he could profitably spare. Most growers probably know good from poor quality cotton and have some idea as to whether their cotton is short or long in staple. Very few, however, know enough about cotton to be certain when they are and when they are not being offered what it is worth.

TABLE 19. NUMBER OF MEMBERS OF COTTON IMPROVEMENT GROUPS INTERVIEWED AND AVERAGE PRODUCTION OF COTTON PER MEMBER, 1941-42.

PARISH	TOTAL MEMBERS INTERVIEWED		MEMBERS WHO SUBMITTED SAMPLES		Per cent of production classed	MEMBERS WHO DID NOT SUBMIT SAMPLES	
	No.	Average production (bales)	No.	Average production (bales)		No.	Average production (bales)
Pointe Coupee	30	38	17	38	85	13	39
Morehouse	38	138	29	137	88	9	141
West Carroll	30	27	15	41	51	15	13
Catahoula	27	10	15	11	89	12	10
TOTAL	125	60	76	71	87	49	43

Six of the 76 members interviewed who submitted samples to the government for classification stated that they knew how to class cotton accurately. Only two of the 49 interviewed who submitted no cotton for classification claimed to know how to class cotton.

Proportion of Cotton Sold Before Class Was Returned

From two to three days ordinarily elapse from the time samples are mailed in the local market until members receive a record of the classification on their cotton. Also, although every effort was made to encourage the mailing of samples promptly, a few of the sampling agencies sometimes held the samples for some time before mailing them. If the growers sell their cotton before receiving a record of the service, the class can be of little benefit to them in the sale of their cotton, although it may still suggest possible future improvements in production, harvesting, and ginning.

The problem of sales prior to the return of the classification to members seems to have been more serious in the groups in Morehouse Parish in 1941-42 than in the other parishes studied (Table 20). In this parish, approximately 18 per cent of the cotton submitted for classification by the members was sold before the class was returned, as compared with 4 per cent in Pointe Coupee and Catahoula Parishes.

TABLE 20. NUMBER OF SAMPLES SUBMITTED FOR CLASSIFICATION BY MEMBERS WHO USED SMITH-DOXEY SERVICE, AND PER CENT OF COTTON SOLD BEFORE CLASS WAS RETURNED, 1941-42.

PARISH	Number of members interviewed	Number of samples submitted	Per cent of cotton sold before class was returned
Pointe Coupee	17	543	4
Morehouse	29	3,496	18
West Carroll	15	322	9
Catahoula	15	143	4
TOTAL	76	4,493	15

Twenty-one of the 76 members interviewed who submitted samples for free classification sold some of the cotton before the class was returned to them. Of this number, 10 stated that they did so because they had an unusually good opportunity to sell immediately and 5 did not consider the government class in choosing the time of sale (Table 21). In the case of two members, their tenants were in a hurry for their money and influenced them to sell. Two other members were themselves financially unable to wait until they received the class.

Proportion of Members' Cotton Submitted for Classification

Those members who took advantage of the program by having their cotton classed did not always have samples from their total production submitted for classification. Forty-three of the 76 members interviewed received the classification on 100 per cent of their production, while the remaining 33 received the classification on only a portion of the bales they produced. About one-half of the total production was classed for members in West Carroll Parish and between 85 and 90 per cent in the other three parishes.

TABLE 21. REASONS WHY SOME COTTON WAS SOLD BEFORE GOVERNMENT CLASS WAS RETURNED, 1939-40 AND 1941-42 SEASONS.

REASON	NUMBER OF MEMBERS	
	1939-40	1941-42
Opportunity to sell to advantage before class returned	6	10
Did not consider Government class in choosing time of sale	2	5
Tenants in hurry to sell	0	2
Financially unable to wait	0	2
Other	2	2
TOTAL	10	21
All bales sold after class returned	35	55
GRAND TOTAL	45	76

The most important reason why samples from all of the bales belonging to the 33 members who received classification on only a portion of their crops were not submitted was that the sampling agency failed to take and ship them all. Sixteen, or almost half of the members, gave this reason (Table 22). Among other reasons given by a few of the

TABLE 22. REASONS WHY SAMPLES FROM ALL ELIGIBLE BALES WERE NOT SUBMITTED BY MEMBERS WHO USED SMITH-DOXEY SERVICE, 1941-42 SEASON.

REASON	NUMBER OF MEMBERS		PER CENT	
	1939-40	1941-42	1939-40	1941-42
Sampler failed to sample all cotton	12	16	27	21
Sold immediately	4	3	9	4
Buyers refused to recognize class	3	2	7	3
Tenants' cotton not classed	0	3	0	4
Class similar for all bales	1	1	2	1
Already getting good price	0	2	0	3
Cotton running low in grade	0	1	0	1
Didn't have supplies for first cotton	3	0	7	0
Cotton similar to buyer's class	2	0	4	0
Weren't interested enough to continue	2	0	4	0
Other	4	5	9	6
TOTAL	31	33	69	43
Samples from total production submitted	14	43	31	57
GRAND TOTAL	45	76	100	100

growers were the following: The cotton was sold immediately; buyers refused to recognize the class; tenants' cotton was not submitted for classification; the grower was already receiving a good price.

Availability of Classing Service From Other Sources

Conceivably, the availability of classing from some other source might affect the extent to which the Smith-Doxey classification was used. The government class given in connection with its loan program was one possible other source which might have been used to some extent by members. In only one parish was classing from other sources than the government loan program and the Smith-Doxey program used. In Pointe Coupee Parish, some members who did and some who did not submit samples for free classification received a class on that portion of their cotton which was shipped to New Orleans and sold through brokers (Table 23).

TABLE 23. PER CENT OF MEMBERS' COTTON CLASSED FOR THEM BY AGENCIES OTHER THAN THE FREE CLASSIFICATION SERVICE, 1940-41 AND 1941-42.

PARISH	MEMBERS WHO SUBMITTED SAMPLES FOR FREE CLASSIFICATION*				MEMBERS WHO DID NOT SUBMIT SAMPLES FOR FREE CLASSIFICATION			
	GOVERNMENT LOAN		OTHER		GOVERNMENT LOAN		OTHER	
	1940-41	1941-42	1940-41	1941-42	1940-41	1941-42	1940-41	1941-42
Point Coupee	22.2	0	5.5	13.0	1.7	0	12.1	39.8
Morehouse	.1	.5	0	0	0	0	0	0
West Carroll	39.5	14.9	0	0	25.8	0	0	0
Catahoula	3.3	0	0	0	2.2	5.0	0	0
TOTAL	7.4	2.0	.7	1.5	2.5	.3	3.2	9.6

*The service was not available in Pointe Coupee and Morehouse Parishes during 1940-41.

All cotton which enters the government loan must first be classed by a board of examiners made up of government classers. Classing offices were operated at various places in Louisiana during the past two seasons for the purpose of classing cotton going into the government loan. Also, the free class obtained under the Smith-Doxey program was acceptable for loan purposes. Since the Smith-Doxey class was free, while charges for the regular loan class ranged from 15c to 20ç per bale, members of cotton improvement groups usually placed their cotton in the loan on the basis of the Smith-Doxey class.

However, the owners of about ¼ of the cotton produced in 1940-41 by members of cotton improvement groups in West Carroll Parish who did not obtain the Smith-Doxey class did obtain a regular government loan class on their cotton. The owners of almost 40 per cent of the cotton produced by members in West Carroll Parish who did submit some samples for free classification also obtained a class through a government loan agency. Part, at least, of this was done in an attempt to check the accuracy of government classing. Not all of the growers who used both services obtained two classes on the same bales of cotton. The situation was similar in the other parishes studied.

Reasons Why Some Members Submitted Samples From None of Their Cotton

The members of cotton improvement groups who submitted no samples of their cotton for free classification advanced various reasons for their action or lack of action. Although no single reason was important for a large majority of the growers in 1941-42, the one most frequently given was that the crop was too small to bother with the service. The crop of some members was almost a complete failure in 1941-42, and they seemed to lose interest in anything connected with cotton for that reason. Eight of the 49 members gave this reason for not submitting samples. Seven others stated that the sampling agency failed to take samples from their cotton. Six failed to submit samples because of a general lack of interest. Five knew the class on their cotton from another source, and another 5 did not know the service was available (Table 24).

TABLE 24. Reasons Why Some Members Failed to Submit Samples for Free Classification, 1939-40 and 1941-42.

Reason	Number of members		Per cent	
	1939-40	1941-42	1939-40	1941-42
Crop too small to bother about classing	0	8	0	17
Lack of interest	23	6	30	12
Knew class from other source	0	5	0	10
Didn't know service available	19	5	24	10
Sampling agent failed to take samples	6	7	8	15
Sold before class returned	7	3	9	6
Person selling for member failed to get sample	6	2	8	4
Doubted if it would help to have class	5	4	6	8
Already getting what cotton worth	4	4	5	8
Too much trouble	3	1	4	2
Other reasons	5	4	6	8
Total	78	49	100	100

The proportion who failed to submit samples because of a lack of interest and because they did not know the service was available was considerably smaller in 1940-41 than in 1939-40. Over 50 per cent of the members did not take advantage of the classing service in 1939-40 because of these two reasons. It seems probable that the beneficial results from the program during the past two seasons have caused many additional growers to become interested in and informed about the free classing service. However, it is apparent that still more educational work regarding the program is needed. Also, the problem of getting samples taken at the gins still appears to be of serious proportions. It is likely that more educational work would also help here, because as more interest is aroused among growers, ginners and warehousemen will be more willing to cooperate in taking samples.

Buyers' Reactions to Program

In the opinion of members interviewed, a large proportion of the cotton buyers reacted unfavorably to their use of government classification and market news. In 1939-40, about 56 per cent of the members, and in 1941-42, about 40 per cent indicated definitely that the buyers' reaction was unfavorable. The proportion of the members who were uncertain regarding the buyers' attitude was 34 per cent in 1941-42, as compared to only 9 per cent in 1939-40, while only 13 per cent indicated that the buyers' reactions were favorable in 1941-42, as compared with over 30 per cent during 1939-40 (Table 25).

Since only one of the parishes was included in the studies for both seasons, it is impossible to say with certainty whether or not the increased uncertainty regarding the buyers' attitudes is merely the result of the difference in sample or whether the buyers are becoming less open in their objections to the program.

TABLE 25. MEMBERS' OPINIONS AS TO BUYERS' REACTION TO USE OF GOVERNMENT CLASSIFICATION AND MARKET NEWS BY MEMBERS IN SALE OF THEIR COTTON, 1939-40 AND 1941-42 SEASONS.

REACTION OF BUYER	NUMBER OF MEMBERS		PER CENT OF MEMBERS	
	1939-40	1941-42	1939-40	1941-42
Favorable	14	10	31	13
Unfavorable	25	30	56	40
Indifferent	2	6	4	8
Uncertain	4	26	9	34
Mixed	0	4	0	5
TOTAL	45	76	100	100

Availability and Use of Market News

It was the duty of group leaders and some of the sampling agenices to post the government price quotations in places where the information would be convenient to growers at the time they sold their cotton. In each of the four areas studied, this information was posted fairly faithfully by a portion of those whose responsibility it was to do so. However, it appears that many of the members were either unaware that the quotations were being posted or thought that they were not easily accessible. About 45 per cent of the members interviewed stated that they did not have access to the quotations, but it is likely that in some of these cases the grower was mistaken. Sixty-one per cent of the members who submitted samples stated that they had access to the quotations, and only 42 per cent reported actually using them. Of those who did not submit samples, 49 per cent stated that they had access to the quotations, and only 27 per cent stated that they made use of them (Table 26).

TABLE 26. Number of Members Having Access to and Making Use of Posted Government Price Quotations, 1941-42.

Parish	Number of members who submitted samples			Number of members who did not submit samples		
	Total	Having access to government quotations	Actually using government quotations	Total	Having access to government quotations	Actually using government quotations
Pointe Coupee	17	9	7	13	3	2
Morehouse	29	21	13	9	6	4
West Carroll	15	7	4	15	8	3
Catahoula	15	9	8	12	7	4
Total	76	46	32	49	24	13
Per cent	..	61	42	..	49	27

Most of those who used the quotations were of the opinion that they helped in selling their cotton. Only 7 of the 45 members who actually used the quotations stated definitely that they did not help. Thirty-five were of the opinion that they did help; three thought they helped some; and 2 were uncertain as to their value (Table 27).

TABLE 27. Opinions of Members as to Extent of Assistance Received Through Use of Posted Government Price Quotations, 1941-42.

Opinion	Members who submitted samples		Members who did not submit samples	
	Number	Per cent	Number	Per cent
Helped in selling	24	31	11	23
Helped some	3	4	0	0
Did not help	3	4	2	4
Value uncertain	2	3	0	0
Total using quotations	32	42	13	27
Total not using quotations	44	58	36	73
Grand total	76	100	49	100

Effect of Class on Price Received

Data with which to measure objectively the effect of government classing on prices received are not available. However, in the opinion of approximately 60 per cent of the members interviewed who had their cotton classed during 1941-42, the possesion of the government class did influence the prices they received. About $\frac{1}{4}$ of the members felt that the government class had no influence, and about 12 per cent were uncertain as to its effect (Table 28). Individual instances were recounted by members in which prices were raised through bargaining anywhere from 5 to 50 points. One member stated that he received $125.00 more on a lot of 50 bales than he would have received without the class. Many members were of the opinion that, even though buyers usually would not admit it, they were frequently influenced by the fact that the grower had a government class.

TABLE 28. MEMBERS' OPINIONS AS TO EFFECT OF GROWERS HAVING A GOVERNMENT CLASS ON THE PRICE RECEIVED, 1941-42.

PARISH	INFLUENCE OF PRICE			Total number interviewed
	Raised	None	Uncertain	
Pointe Coupee	9	4	4	17
Morehouse	18	10	1	29
West Carroll	9	4	2	15
Catahoula	10	0	5	15
TOTAL	46	18	12	76
Per cent of total	60	24	16	100

Usefulness For Quality Improvement

In addition to its use as a tool for more effective bargaining in the sale of cotton, there are reasons to believe that the free information regarding the grade and staple length, and market price of different qualities of cotton is having an important effect on production, harvesting, and ginning practices in the state. Farmers are interested in producing better qualities of cotton only when it is profitable for them to do so. This means that they must know what premiums are being offered in the market for the better qualities of cotton and they must have sufficient knowledge of the quality of their own cotton so as to know what premiums to expect.

The importance of quality to the price received for cotton is shown in Table 29, which gives the premiums and discounts for various grades and staple lengths for certain years. Within the last year the amount of the variation in price for different qualities was increased greatly. For instance, in October 1942 a bale of Middling $1\frac{1}{8}$ inch cotton was worth 425 points or $21.25 per 500 pound bale more than a Middling 15/16 inch bale. In 1940 the average difference was only 167 points or $8.35 per bale. The discounts for short staple cotton and low grades have also widened considerably, although not as much as the premiums for the longer staples.

Information such as this has enabled many farmers to appreciate far more than they formerly did the importance of producing the right kind of cotton and selling it at a price in line with its true market value. A correct class on each bale of cotton sold is necessary before this can be done. The government classification has indicated to many cotton growers that cleaner picking results in better grades, and that the ginning of wet or green cotton results in lower grades. Usually the extra cost of getting reasonably clean and dry cotton to the gin is only a small fraction of the extra returns received when the cotton is sold.

TABLE 29. PREMIUMS AND DISCOUNTS FOR COTTON OF VARIOUS GRADES AND STAPLE LENGTHS.

GRADES AND STAPLE LENGTHS OF WHITE COTTON	PREMIUMS (+) AND DISCOUNTS (−) IN POINTS (Hundredths of cent per pound)*				
	1937	1938	1939	1940	Oct. 1942
Grades					
Middling Fair	+ 64	+ 68	+ 53	+ 57	+ 58
Strict Good Middling	+ 57	+ 57	+ 48	+ 51	+ 50
Good Middling	+ 50	+ 51	+ 42	+ 45	+ 42
Strict Middling	+ 36	+ 34	+ 29	+ 32	+ 31
Middling	base	base	base	base	base
Strict Low Middling	− 62	− 61	− 54	− 52	− 120
Low Middling	− 162	− 151	− 120	− 124	− 334
Strict Good Ordinary	− 253	− 228	− 182	− 185	− 494
Good Ordinary	− 317	− 289	− 240	− 234	− 592
Staple lengths					
$^{13}/_{16}$ inch	− 146	− 123	− 87	− 81	− 155
$^{7}/_{8}$ inch	− 43	− 30	− 19	− 21	− 90
1 inch	+ 37	+ 24	+ 17	+ 20	+ 28
1$^{1}/_{16}$ inch	+ 73	+ 56	+ 37	+ 46	+ 130
1$^{1}/_{8}$ inch	+ 203	+ 170	+ 150	+ 167	+ 425
1$^{3}/_{16}$ inch	+ 355	+ 299	+ 331	+ 451	+ 813
1$^{1}/_{4}$ inch	+ 507	+ 499	+ 473	+ 644	+1103

*Based on middling white $^{15}/_{16}$ inch cotton.

A number of producers during the past two seasons have settled with their tenants on the basis of the grade and staple length of the cotton each tenant produced. In this manner, the tenants were rewarded for superior quality of work and penalized for inferior. This might easily develop into a matter of great importance in the plantation sections of the state.

FUTURE PROSPECTS OF THE PROGRAM

It seems evident from the increased number of samples submitted for free classification by members of cotton improved groups that the program has been of considerable benefit to cotton growers. The number of bales classed was 3,456 per cent larger in 1940-41 than it was in 1939-40. The majority of the growers were very favorably inclined toward the program despite the fact that in some cases the benefits could not be easily measured.

Sixty-nine of the 76 members interviewed who submitted samples for classification during 1941-42 indicated definitely that they planned to submit samples in 1942-43. Five members were uncertain as to whether or not they would participate in 1942-43, and only two stated that they did not plan to do so. Thirty-three of the 49 members interviewed who did not submit samples in 1941-42 stated that they planned to participate in the program during the next season; 12 were uncertain; and 4 did not plan to participate.

Thus, it appears probable that the program will reach an even larger number of cotton growers in 1942-43. Within the next few years, the rate and extent to which the program may continue to expand will undoubtedly depend upon the extent to which the more serious problems now existing are solved. Perhaps, the most obvious need is for more educational work to acquaint farmers, especially those who produced only a few bales, with the value of the services they can obtain from using the program. Much progress has been made along this line but much more remains to be done. In 1941-42, one-tenth of the members of cotton improvement groups who did not use the free classing service stated that they did not know it was available.

The problem of getting more use of the program by farmers who produce small crops is important. The total amount of cotton produced by such farmers is not very large, but the number of individuals who might be benefitted by use of the program is considerable. The amount of benefit to be received by such farmers should be fully as great, relative to the size of their operations, as that obtained by farmers with larger crops.

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Recommendations for a Sugarcane Borer Control Program in Louisiana

By

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RECOMMENDATIONS FOR A SUGARCANE BORER CONTROL PROGRAM IN LOUISIANA

Summary

To destroy overwintering borers.

1—Burn trash, cane pieces, tops, grasses, etc., thoroughly.
2—Shave summer planted cane and burn shaved-off plants.

To control first generation borers.

3—Dust cane with cryolite.
4—Cut out or rogue dead hearts.
5—Cut out and destroy heavily infested early corn.

To control second generation borers.

6—Release Trichogramma.
7—Dust cane with cryolite.

To insure good stands and healthy plant cane.

8—Plant borer-free cane.

To decrease number of borers entering hibernation.

9—Cut cane at ground level.
10—Make thorough clean-up during harvest.

Recommendations 1, 2, 8, 9, and 10 should be established farm practices on all sugarcane farms. The extent and level of the borer infestation would determine the choice of other measures.

Recommendations for a Sugarcane Borer Control Program in Louisiana

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INTRODUCTION

A number of very definite recommendations for the control of the sugarcane borer have resulted from many years of extensive observations and experimental research by State and Federal workers. All of these recommendations fit into a borer control program, which appears essential for the successful control of the borer, a pest which accounts for an annual loss of about $5,000,000 to the sugarcane industry. Since each of these control measures have certain advantages as well as limitations, the ones most applicable to the particular borer problem on hand should be applied. An adoption of a combination of practices rather than the use of a certain one is absolutely necessary in an effort to hold the borer under control for any period of time. For example, dusting may serve to prevent serious injury during one season, but unless followed by the planting of borer-free cane; a thorough clean-up during harvest; and a complete destruction of overwintering material left in the field; the progress made in decreasing the infestation may be lost the following season. A united effort to continually strive to lower the infestation to a harmless level through a borer control program is undoubtedly the logical approach to the problem.

The following recommendations are considered in the order in which they should be applied during the year and are grouped according to the purpose which they accomplish. The number of each recommendation corresponds to that on the chart in the center of this bulletin, on which may be seen just how each fits into a borer control program.

RECOMMENDATIONS

To Destroy Overwintering Borers

1—*Burn trash, cane pieces, tops, grasses, etc., thoroughly.*

Cane trash left in the fields during harvest is by far the most important source of borer infestation the following spring. A very special effort should be made by every cane grower to burn all trash and clean up the fields as thoroughly as possible.

Quite extensive observations have shown that thorough burning destroys approximately 75 per cent of the overwintering borers. Even though trash is to be chopped or disked before burying, it should be burned first. Further, if in a heavily infested field, a thorough burning is not obtained the first time, it would be advisable to pile up the remaining material and reburn. All large stem grasses, corn stalks and the like in which borers may be overwintering should be cut and burned. The burning of trash has no effect upon the survival of *Trichogramma,* the very important borer egg parasite, as was thought at one time.

It must be added that too much emphasis cannot be placed on the destruction of overwintering borers.

2—*Shave summer planted cane and burn shaved-off plants.*

A very heavy borer population may be found overwintering in shoots of summer planted cane. A growing popularity of summer planting warrants a special recommendation for destroying overwintering borers in such plantings.

After the plants have been killed-down by cold, they should be shaved-off, preferably in late February, and the shaved-off plants burned. Be sure to shave low enough to cut off the joints in which the borers are overwintering. Heavy concentration of borers in summer planted areas may become the source of substantial spread into adjoining cane in the spring.

To Control First Generation Borers

First generation borers are those developing from eggs laid by moths from overwintered larvae. They begin to appear in large numbers about April 15 to 30, the rate of development varying with weather conditions. There are no joints on the plants during the first generation attack, so the control of this generation does not mean the protection of any joints at the time, but the lowering of the population of later generations, which of course do attack joints. Therefore, the area treated for first generation control, whether by dusting or rogueing, to be of value at harvest-time must include enough of the infested area to prevent reinfestation by later generations from untreated cane.

3—*Dust cane with cryolite.**

First generation dusting is recommended for treatment of an entire plantation; for heavily infested areas from which there may be a substantial spread of borers into adjoining areas; and for smaller areas with a localized infestation. First generation dusting should never be done in a small part of a large infested area, because of likely reinfestation from untreated cane. The following points are important for successful control:

a—Dust four times at weekly intervals, beginning with the first emergence of young borers. The time of emergence of young borers may be determined by borer egg collections to find out when hatching begins,

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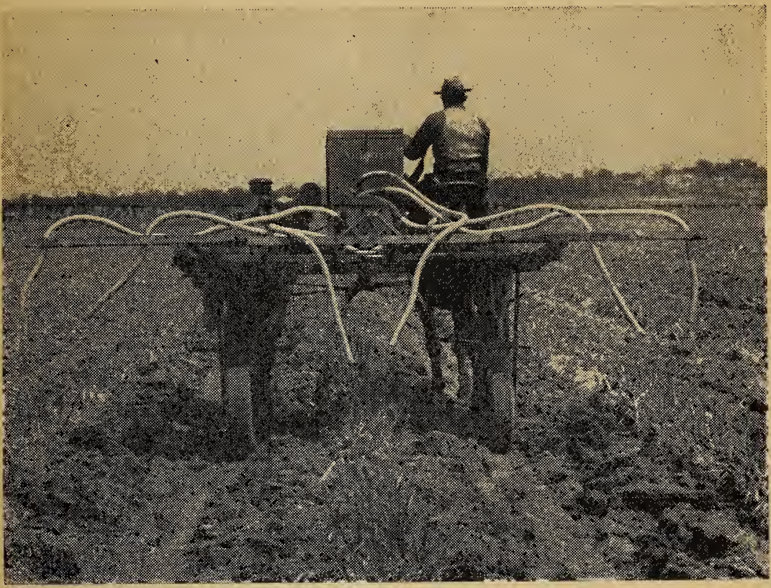
Cryolite control was developed through cooperative work between the Louisiana Agricultural Experiment Station and the U. S. Bureau of Entomology and Plant Quarantine.

or more easily by leaf perforations, the presence of which indicate borers are hatching and have begun feeding.

b—Apply dust at the rate of about 8 pounds per acre per application with a power machine, and 10 pounds with a hand gun, while the air is quiet and dew is on the plants, which is usually between 6 p.m. and 9 a.m.

c—A power machine is essential for treating large areas, but rotary hand guns may be used in smaller areas.

d—With a power dusting machine, two nozzles to the row are preferable to one, especially in cane of a heavy stand.

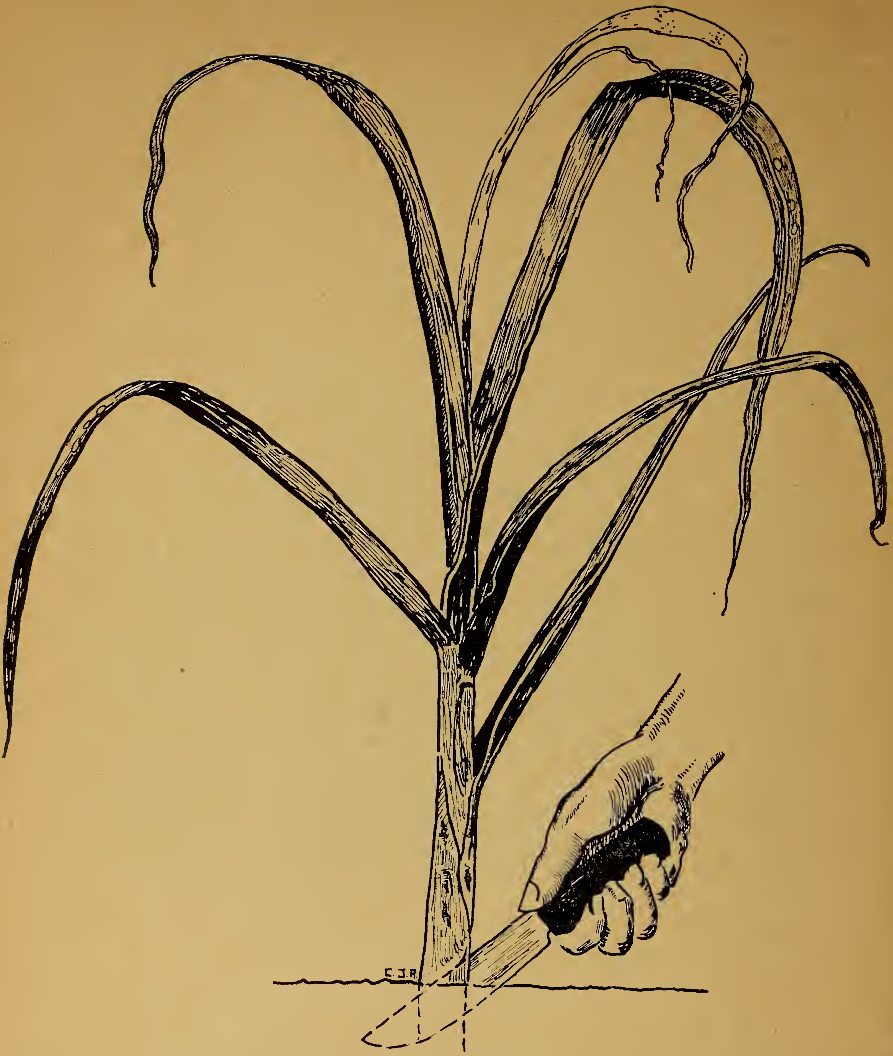


Dusting for first generation borer control, using two nozzles to each row, and covering three rows of cane each trip. The above dusting machine is being pulled by two mules, but can be attached to a tractor.

About 10 acres can be treated per hour with a 3-row ground dusting machine and about 15 acres per hour with a 5-row machine. One man with a hand gun should dust about one acre per hour. The estimated cost of dusting first generation borers with power machines is $5.50 per acre for the four applications; and with hand guns, about $6.00.

4—*Cut out or rogue dead hearts.*

The rogueing of dead hearts is recommended for areas with a light infestation, and as a follow-up of dusting to destroy any borers which may have survived the dusting treatment. Do not rogue under conditions of a heavy infestation. After a heavy infestation has been reduced to a low level by dusting then rogueing may replace the dusting in following years as long as the borer population remains low. The possibilities of reinfestation applies to rogueing just as to dusting for first generation control.



The above figure illustrates the cutting out of a dead heart below the surface of the ground in order to include the borer stage. Cut low enough so as not to leave the borer in the stubble.

In cutting out or rogueing dead hearts, the result of first generation injury, special care should be taken *to rogue each time before moths begin to escape; to cut the shoots low enough to get the borer; and to destroy the borer stage to prevent continued development in the rogued plants.*. The success of rogueing depends upon the following:

a—Use only extra-dependable laborers for rogueing.

b—Begin the first rogueing when dead hearts become numerous, and when full grown borers or young pupae are found. The object is to secure as large a proportion of dead hearts at each rogueing as possible, without allowing the escape of moths. The time to begin is usually about the last week of May.

c—A field should be rogued at least 3 times at about 10 day intervals to get additional dead hearts as they develop.

d—Knives with blades 6 to 8 inches long should be used in order to cut the plants within the ground, below the lower end of the borer tunnel.

e—The safest practice is to slit each dead heart immediately and destroy the borer stage therein.

f—No attempt should be made to remove dead hearts later than for first generation borers, since a very small proportion of borer-infested plants by later generations show dead heart injury.

The use of rogueing dead hearts is limited because of the type and number of laborers needed for successful results. This practice comes at the time that labor is most needed for other farm operations.

5—*Cut out and destroy heavily infested early corn.*

Quite frequently heavy first generation infestations are concentrated in rather small areas of early developing corn, from which spread may occur. An average of 8 to 10 borer stages (larvae and pupae) per stalk of corn is not uncommon in a heavily infested field. Thus, it is recommended that such fields of corn be cut and fed to livestock or otherwise destroyed before there is a movement of moths into adjoining cane.

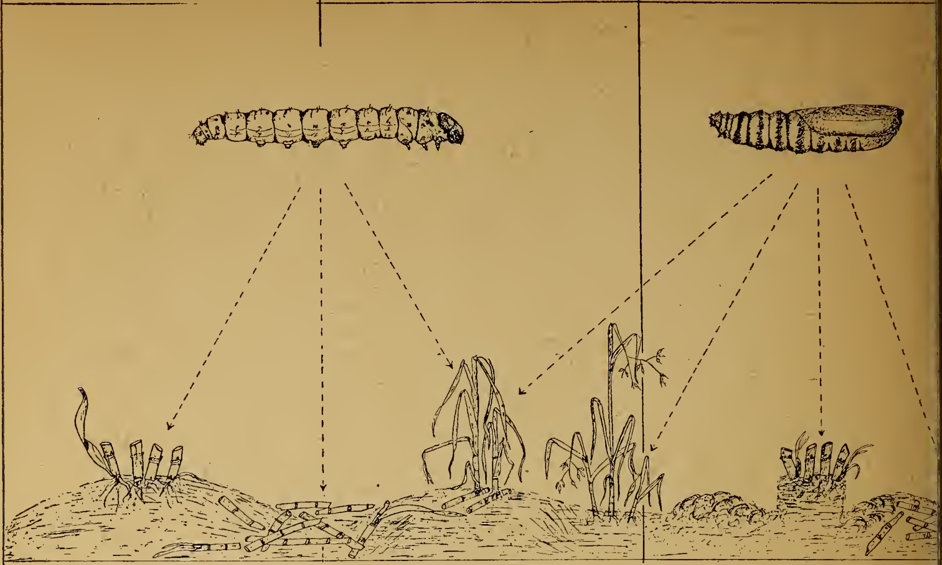
To Control Second Generation Borers

Second generation borer eggs begin to appear in large numbers about June 6 to 12, and young borers start to hatch generally about June 12 to 25. It is the second generation of borers which does the most damage, and unlike the results of first generation injury which disappears with the drying-up of dead hearts, the injury by the second generation is visible and measurable at harvest time in the form of bored joints and stunted stalks.

6—*Release Trichogramma.*

Since it is generally recognized that the growing of sugarcane profitably in Louisiana would no doubt be impossible without the aid of *Trichogramma* in helping to control the borer, and in view of extensive experimental evidence that when this parasite is prevented from attacking only second generation borer eggs that about 25 per cent more borer damage results, it is recommended that Trichogramma be artificially released when necessary to maintain the parasite population at the highest possible level. It has been observed that the natural parasitism of borer eggs by this parasite has been high early in the season in most fields for a number of years, but in such fields where early natural parasitism is not high, releases should be made.

JANUARY	FEBRUARY	MARCH



Borer overwintering in cane pieces, tops, young plants of summer planted cane, stubbles, grasses, etc.

(1) *Burn trash, cane pieces, tops, grasses, etc., thoroughly.*

(2) *Shave summer planted cane and burn shaved-off plants.*

Larva transforms to pupa, or resting stage, in overwintering material.

JULY	AUGUST	SEPTEMBER

Second generation borers injure lower joints, stunt stalks, cause some dead tops.

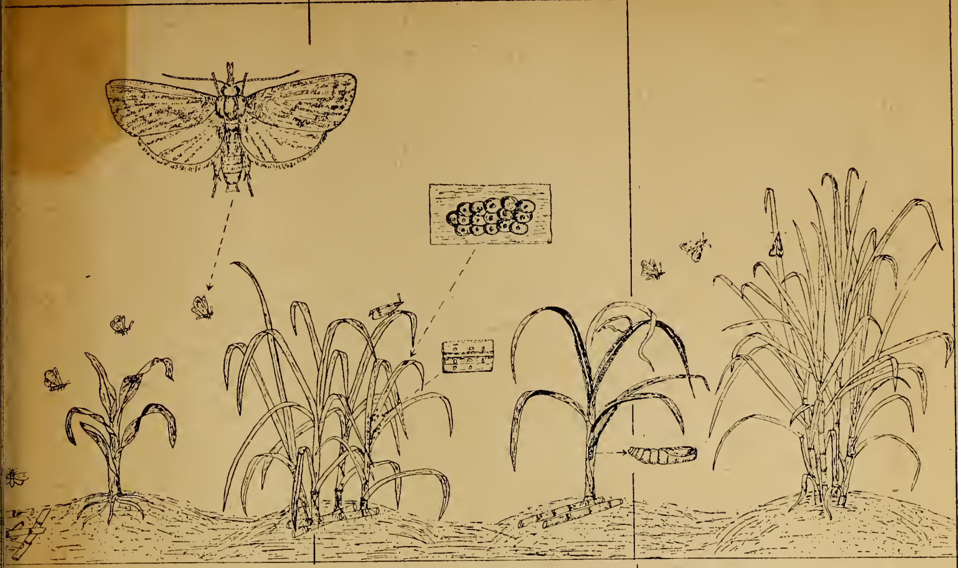
Moths lay eggs for third generation.

Trichogramma parasitism of borer eggs increases.

Fourth and occasional fift generation develop, causin bored joints, dead tops, broken tops.

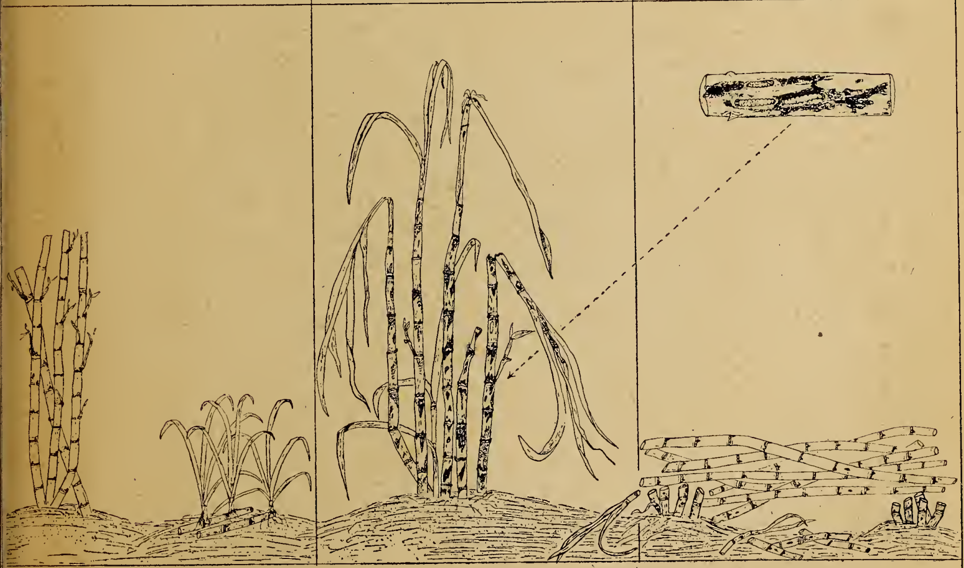
Chart showing seasonal history of the sugarcane borer, *Diatraea saccharalis* (F.) in Louisiana, and the co in cane pieces, tops, stubs, etc. Overwintered borers begin to mature in large numbers about April 15 to in a straight line across the leaf, are the first signs of borer work. In late May and June, deadhearts or moths begin laying eggs for second generation about June 20 to 25. Both the first and second generation ter. Natural parasitism of borer eggs, by *Trichogramma,* begins in the second generation and increases t winter. (Prepared by A. L. Dugas, Louisiana Agricultural Experiment Station.)

APRIL	MAY	JUNE



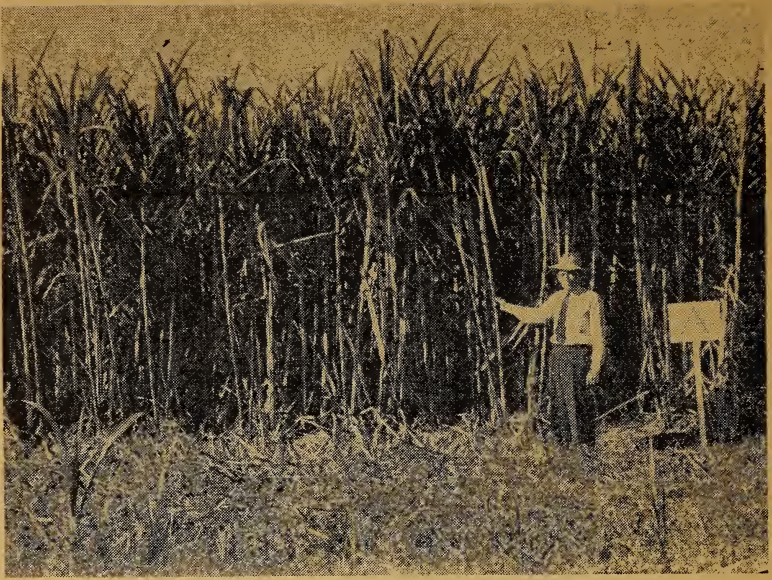
APRIL	MAY	JUNE
Moths emerge and lay eggs on young corn and cane for first generation. Leaf perforations soon appear. (3) *Dust cane with cryolite.*	Result of first generation injury is a dead heart or dying of the plant. (4) *Cut out or rogue dead hearts.* (5) *Cut out and destroy heavily infested early corn.*	Moths emerge from dead hearts and infested corn; lay eggs for second generation. (6) *Release Trichogramma.* (7) *Dust cane with cryolite.*

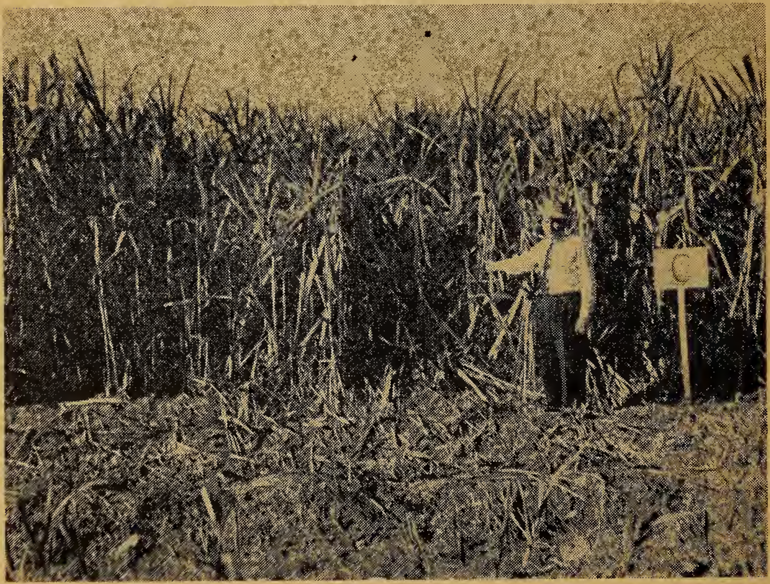
OCTOBER	NOVEMBER	DECEMBER



OCTOBER	NOVEMBER	DECEMBER
Bored seed cane results in poor stands, reduced vitality of plants. (8) *Plant borer free cane.* (9) *Cut cane at ground level.*	Severe injury reduces yield of cane and of sugar. Increases cost of harvesting.	Harvesting completed. Borers remain in cane pieces, etc. (10) *Make thorough cleanup during harvest.*

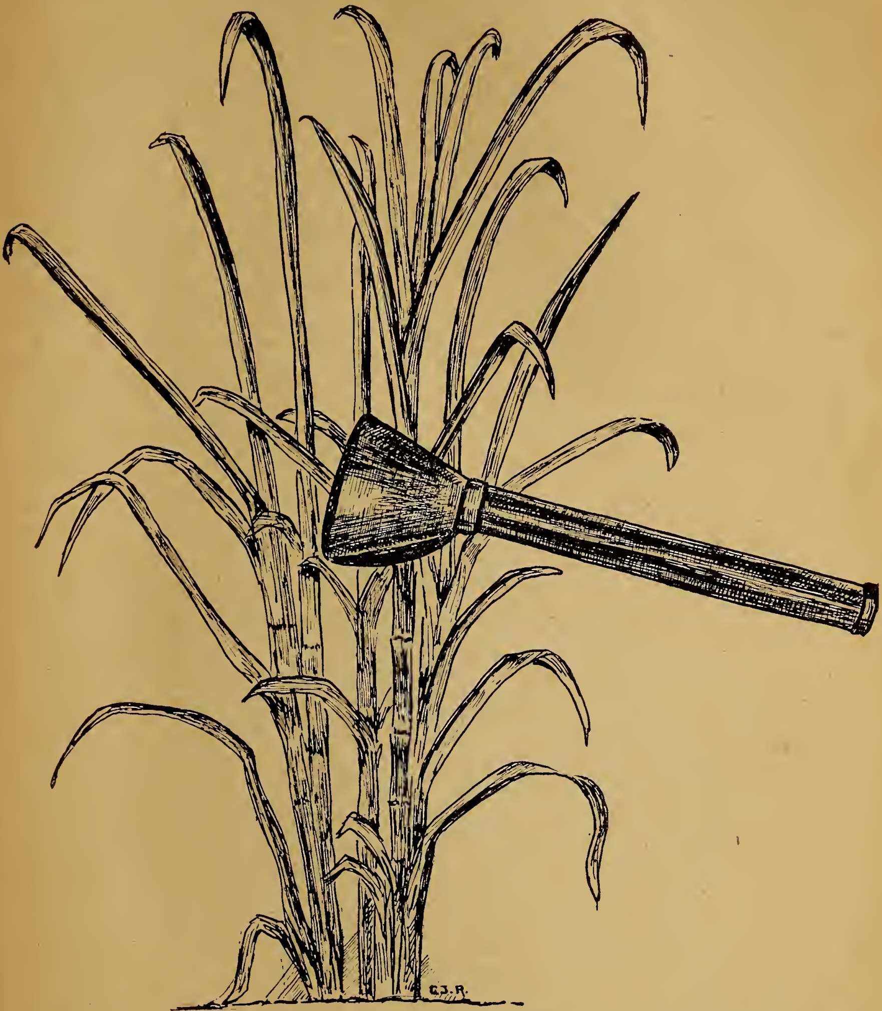
l recommendations for this pest. During late fall and winter, November to March, borers are hibernating
. Moths fly over to young corn and cane to lay eggs for first generation. Leaf perforations, or small holes
ng of the central whorl of the plants, follow first generation attack. Borers reach maturity in June and
emerging over about a month period. A third, fourth, and occasional fifth generation develop before win-
ughout the season. Borers remain in cane pieces and other material left in the fields, where they pass the





The photographs above were taken in the fall of 1942 on a St. Mary Parish plantation, and show the striking difference between dusted and undusted cane in a small plot experiment for second generation borer control. The variety of cane is C.P. 29-103, and the top picture, labeled "A," shows the effects of dusting with cryolite as compared with an undusted plot, below, labeled "C."

Trichogramma releases never give as complete control as dusting cryolite on the second generation, and should never be used to replace dusting. Releases should be made with the idea of maintaining the highest possible parasite population and thereby increase its usefulness in supporting all other control practices.



The above figure shows the position of the nozzle of the hand gun in second generation dusting for borer control. The dust must be directed down into the bud and leaf sheaths.

In making releases, about 5,000 parasites to the acre should be sufficient. If fresh borer eggs should appear earlier in corn, then the first releases should be made in the corn. Scatter them through the field by holding the container open above the head in going down about two rows in each cut of cane to be colonized. The total number per acre should be divided into at least two releases. Always keep the parasites away from direct sun and release them as soon as a majority seem to have emerged in the cup container.

7—*Dust cane with cryolite.*

Dusting for second generation control is recommended for smaller areas, such as seed plots or only a part or parts of infested areas, where there is danger of reinfestation from adjacent untreated cane. This control measure is the only one that can be used successfully in treating a small area surrounded by a fairly heavy infestation. If a large area or a whole plantation were not dusted for first generation control and then it became evident that a heavy infestation was present, either could be dused for second generation by airplane. It would hardly be possible to dust a whole plantation at this time with a power ground machine, because of the height of the cane and difficulty in getting through the fields.

a—As in first generation dusting, make 4 applications at weekly intervals, beginning with the first emergence of borers.

b—Apply dust when the air is quiet and dew is on the plants, which is usually between 6 p.m. and 9 a.m., at the rate of about 10 pounds per acre per application.

c—A power ground machine built high enough so as not to break the cane may be used in reasonably large areas. Hand guns or saddle guns are entirely practical for treating areas up to about 30 acres. Large scale dusting would necessarily have to be done by plane.

To Insure Good Stands and Healthy Plant Cane

8—*Plant borer-free cane.*

Select seed cane as lightly infested as possible, or protect seed plots from borer injury. In many instances, even after normal expenditures have been made for disease control in seed plots, they are not fit for use and must be abandoned because of severe borer damage.

Heavily bored seed cane often gives poor standards and lower yields of plant cane and subsequent stubble crops. In heavily bored cane, many of the eyes have been killed by borers and the borer entrance and exit holes together with severe tunneling offers optimum conditions for entrance and development of red rot disease, which destroys additional eyes and generally weakens the vitality of the plants to follow.

To Decrease Number of Borers Entering Hibernation

9—*Cut cane at ground level.*

In harvesting, cane should be cut at ground level or just below the ground level to reduce the number of borers overwintering in cane stubbles, where they are not likely to be destroyed by unfavorable weather conditions or by artificial methods of disposal of cane trash. Cutting of cane lower, to include the first joints, also increases sugar production.

10—*Make thorough clean-up during harvest.*

As emphasized before, the cane stalks and pieces left in the field during harvest are the important material in which borers overwinter. A more thorough clean-up of millable cane and cane pieces should be made in the fields, along roadways and railroads, and around hoists and sugar houses to reduce the number of borers entering hibernation from which the infestation is started the following spring. It is far better to harvest clean than to rely upon burning after harvest to destroy material in which borers may be overwintering.

On many plantations, it has been found that a man and a cart following the cane loader have picked up enough millable cane and pieces to more than pay for the operation, in addition to decreasing the number of borers entering hibernation in their fields and the resulting borer infestation the next year. This should be a common practice on all places.

DISCUSSION

Now, that such a number of excellent borer control recommendations are available, how can they be used to the best advantage? First, it has become apparent that the larger the area treated for borer control the more successful is the effort. Therefore, a borer control program to include a whole parish should be undertaken, with the best practical use made of all of the foregoing recommendations in attacking the many borer problems throughout the parish. Every farm should be included in the program, and it should resort to the measures best suited to solve the borer problem on each particular farm. Certain of these control measures should be used on all farms; namely, making a thorough clean-up during harvest, burning of trash, and planting of borer-free cane. These should be generally accepted as farm practices on every farm where sugarcane is grown. Then the size of the infested area and the level of infestation should determine the selection of additional measures.

On many farms no such additional measures would be necessary because of the lack of a borer infestation, but on many others it would be a matter of choosing between first generation dusting, rogueing dead hearts, or second generation dusting. Of course, *Trichogramma* should be released where necessary to support the whole program. In general, dusting either for first or second generation control, but never for both in the same field, would take care of any borer situation. But in the case of a light infestation, provided suitable labor is available, the rogueing of dead hearts may be used at a lower cost. Now in event of a heavy infestation, dusting is the only remedy, and it would have to be decided whether the first or second generation would be dusted.

If the whole or a larger part of the infested area were to be treated, then it would be recommended that first generation dusting be done, since the operation is so much easier when the cane is small and more would be accomplished toward destroying the whole borer population. Now, if one is not interested in participating in the program, and cares to treat only a small part or parts of the infested area, then second generation dusting would be recommended, since the problem of reinfestation is not as important as in the case of first generation dusting. It must always be remembered that first generation dusting in a small part of an infested area would be worthless, unless it were done with the idea of destroying a very heavy concentration of borers in some particular place. Naturally, second generation dusting follows the first, so in the event a large number of dead hearts should appear in certain areas or over the entire place, then second generation dusting over the whole place by plane or in smaller areas by ground machine or hand guns would be advisable.

In any case it would be very important that the dusting or rogueing be followed by clean-up during harvest and a thorough burning to further decrease the borer population the next year. Every effort should be directed toward decreasing the borer population to the lowest possible level on every farm and over the whole parish and to hold it down. Then the maximum benefits from borer control work shall be attained.

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